Scientific and Technical Aerospace Reports

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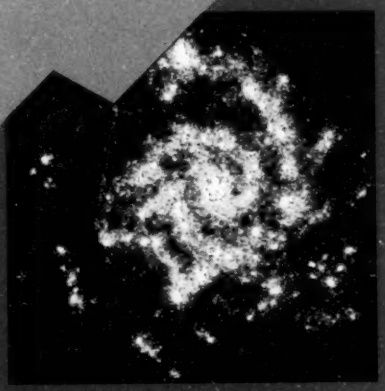

An Abstract Journal

NASA STI PROGRAM SCIENTIFIC & TECHNICAL INFORMATION

Volume 30, Number 13
July 8, 1992
N92-22096 to N92-23120

Scientific and Technical Aerospace Reports

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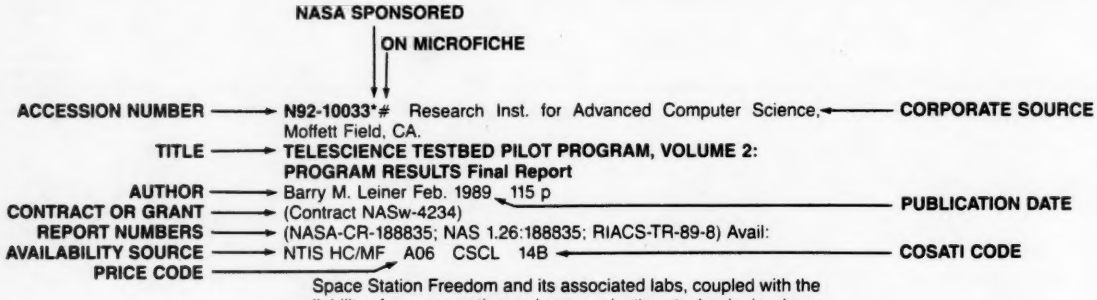
TYPICAL CITATION AND ABSTRACT



Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.

Author

VOLUME 30 NUMBER 13 / JULY 8, 1992

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N92-22505*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE HIGH RESOLUTION ACCELEROMETER PACKAGE (HiRAP) FLIGHT EXPERIMENT SUMMARY FOR THE FIRST 10 FLIGHTS
Robert C. Blanchard, K. T. Larman, and M. Barrett (Lockheed Engineering and Sciences Co., Hampton, VA.) Apr. 1992 318 p
(NASA-RP-1267; L-16900; NAS 1.61:1267) Avail: NTIS HC/MF A14 CSCL 01B

The High Resolution Accelerometer Package (HiRAP) instrument is a triaxial, orthogonal system of gas damped accelerometers with a resolution of 1 x 10(exp -6) g (1 micro-g). The purpose of HiRAP is to measure the low frequency component of the total acceleration along the orbiter vehicle (OV) body axes while the OV descends through the rarefied flow flight regime. Two HiRAP instruments have flown on a total of 10 Space Transport System (STS) missions. The aerodynamic component of the acceleration measurements was separated from the total acceleration. Instrument bias and orbiter mechanical system acceleration effects were incorporated into one bulk bias. The bulk bias was subtracted from the acceleration measurements to produce aerodynamic descent data sets for all 10 flights. The aerodynamic acceleration data sets were input to an aerodynamic coefficient model. The aerodynamic acceleration data and coefficient model were used to estimate the atmospheric density for the altitude range of 140 to 60 km and a downrange distance of 600 km. For 8 of 10 flights results from this model agree with expected results. For the results that do not agree with expected results, a variety of error sources have been explored. Author

N92-22659*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RESEARCH AND TECHNOLOGY, 1991
1991 169 p
(NASA-TM-105320; E-6677; NAS 1.15:105320) Avail: NTIS HC/MF A08 CSCL 01B

NASA Lewis' research and technology accomplishments are summarized for the fiscal year 1991. Approximately 150 articles are presented which were submitted by the technical directorates. There are six major sections: Aeronautics; Aerospace technology; Space flight systems; Space Station Freedom; Engineering and Computational support; and Lewis Research Academy. A table of contents by subject was developed to assist the reader in finding articles of special interest. For each article, a Lewis contact person is identified, and where possible, a reference document is listed so that additional information can be easily obtained. The diversity of topics attests to the breadth of research and technology being pursued and to the skill mix of the staff that makes it possible. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-22135 Ohio State Univ., Columbus.
AN INVESTIGATION OF UNSTEADY PRESSURE AND TEMPERATURE CHARACTERISTICS DUE TO SHOCK-BOUNDARY LAYER INTERACTIONS IN A MACH 6 AXISYMMETRIC FLOWFIELD Ph.D. Thesis
Michael John Flanagan, Jr. 1991 167 p
Avail: Univ. Microfilms Order No. DA9130475

Pressure and temperature fluctuations have been measured in the vicinity of shock wave-boundary layer interactions due to conical compression ramps on an axisymmetric body. The basic model is a cylindrical body with a 10 degree conical nose. Four conical ramps, 20, 25, 30, and 35 degree serve as shock wave generators. Flowfield surveys have been made in the vicinity of the conical ramp vortex, the separation point, and the reattachment point. A significant effort was made to characterize the natural frequencies and relative power of the fluctuations. The temperature response within the flow field appears to be steady-state for all compression ramp angles and all Reynolds numbers. These data indicate the flowfield to be steady-state for all locations with the exception of localized pressure fluctuations in the vicinity of the separation point. The driving mechanism for these oscillations has not yet been determined; however, the low frequencies of these fluctuations strongly suggest a link to the fluid flow within the separated region, rather than the incoming boundary layer. Dissert. Abstr.

N92-22179# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
CONTRIBUTIONS OF MBB-FE211 TO THE 2ND ANTIBES WORKSHOP ON HYPERSONIC FLOWS
Francois Monnoyer 30 Apr. 1991 99 p Presented at Workshop on Hypersonic Flows for Reentry Problems, Part 2, Antibes, France, 15-19 Apr. 1991
(MBB-FE211-S-PUB-449; ETN-92-90619) Copyright Avail: NTIS HC/MF A05

Calculations performed with the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for the Navier-Stokes equations for a wide range of Mach numbers) on the following are illustrated: flow over a two dimensional ramp; double ellipsoid; and a delta wing. Euler boundary layer calculations for ellipsoid and blunt nose delta wing are illustrated. For individual titles, see N92-22180 through N92-22184.

N92-22180# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
PROBLEM 3: FLOW OVER A 2-D RAMP NAVIER-STOKES CALCULATIONS
J. Fischer and M. Schmatz *In its* Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows 30 Apr. 1991 p 1-17 (For primary document see N92-22179 13-02)
Copyright Avail: NTIS HC/MF A05

Calculations of flow over a two dimensional ramp using the finite volume Navier-Stokes code NSFLEX (an implicit relaxation

method for a wide range of Mach numbers) are illustrated. The inviscid flow fluxes are calculated at the volume faces with a Riemann solver. A third order accurate local characteristic flow extrapolation scheme is used with van Albada sensors to detect nonmonotonous behavior of flow variables. At very strong shocks, a modified hybrid Steger-Warming local characteristic flux is applied. Viscous fluxes are constructed with central differencing at the cell faces. The unfactored time dependent implicit equations converge in time with a point Gauss-Seidel relaxation algorithm. ESA

N92-22181# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
CASES 6.1 AND 6.8 DOUBLE ELLIPSOID: NAVIER-STOKES CALCULATION
M. Schmatz and R. Hoeld *In its* Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows 30 Apr. 1991 p 18-37 (For primary document see N92-22179 13-02)
Copyright Avail: NTIS HC/MF A05

Calculations of flow over a double ellipsoid using the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for a wide range of Mach number) are illustrated. The inviscid fluxes are calculated at the volume faces with a Riemann solver. A third order accurate local characteristic flux extrapolation scheme is used with van Albada sensors to detect nonmonotonous behavior of the flow variables. At very strong shocks, a modified hybrid Steger-Warming local characteristic flux is applied. The viscous fluxes are constructed with central differencing at the cell faces. The unfactored time-dependent implicit equations are converged in time with a point Gauss-Seidel relaxation algorithm. ESA

N92-22182# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
CASE 7.4 DELTA WING: NAVIER-STOKES CALCULATION
R. Hoeld and M. Schmatz *In its* Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows 30 Apr. 1991 p 38-57 (For primary document see N92-22179 13-02)
Copyright Avail: NTIS HC/MF A05

Calculations of flow over a delta wing using the finite volume Navier-Stokes code NSFLEX (an implicit relaxation method for a wide of range of Mach numbers) are illustrated. The inviscid fluxes are calculated at the volume faces with a Riemann solver. A third order accurate local characteristic flux extrapolation scheme is used with van Albada sensors to detect nonmonotonous behavior of the flow variables. At very strong shocks, a modified hybrid Steger-Warming local characteristic flux is applied. The viscous fluxes are constructed with central differencing at the cell faces. The unfactored time-dependent implicit equations are converged in time with a point Gauss-Seidel relaxation algorithm. ESA

N92-22183# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
CASE 6.1 AND 6.8 ELLIPSOID: EULER-BOUNDARY LAYER CALCULATION
Francois Monnoyer *In its* Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows 30 Apr. 1991 p 58-77 (For primary document see N92-22179 13-02)
Copyright Avail: NTIS HC/MF A05

Flow around an ellipsoid is presented. The model applied is a coupled Euler boundary layer model. The Euler equations are solved using Pfitzner's EULSPLIT code. In the inner viscous region, the second order boundary layer equations are solved using Monnoyer's SOBOL code. A defect formulation of the boundary layer equations is used to take second order effects typical of hypersonic flows, such as entropy swallowing and external vorticity, into account. No displacement effect is included in the results presented. ESA

N92-22184# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
CASE 7.4: BLUNT NOSE DELTA WING EULER-BOUNDARY LAYER CALCULATION
Francois Monnoyer *In its* Contributions of MBB-FE211 to the 2nd Antibes Workshop on Hypersonic Flows 30 Apr. 1991 p 78-96 (For primary document see N92-22179 13-02)
Copyright Avail: NTIS HC/MF A05

Flow around the blunt nose of a delta wing is presented. The model applied is a coupled Euler boundary layer method. The use of boundary layer theory makes it possible to predict the flow around a body with a combination of viscous and inviscid models applied in their regions of validity and combined with each other at their common boundary. Perfect matching of the inner boundary layer and the inviscid external flow is obtained by the use of defect formulation. ESA

N92-22193# Cambridge Univ. (England). Dept. of Engineering.
A THEORETICAL INVESTIGATION OF THE INDUCED DRAG OF WING OF FINITE ASPECT RATIO
F. Lam Dec. 1991 50 p Sponsored in part by Croucher Foundation and Trustees
(CUED/A-Aero/TR-17(1991); ISSN-0309-7293) Avail: NTIS HC/MF A03

The Lanchester-Prandtl lifting-line theory for finite aspect ratio wings has been revised with an entirely new model of trailing vortex wake which takes into account the mean effect of the roll-up of the trailing vortex sheet. Comparison with the original planar model shows that the downwash induced by the proposed wake can be usefully low for given loadings over a range of downstream distance, within which a trailing vortex sheet has reached a state of concentrated vortices. The induced drag is consequently lowered due to the favorable upwash generated by the roll-up vortices. There exists an optimum downstream location for the completion of the roll-up process which gives rise to a minimum drag in each loading case examined in this paper. This minimum is even lower than the least drag predicted by the classical lifting-line theory. Author

N92-22196*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE NASA LANGLEY LAMINAR-FLOW-CONTROL EXPERIMENT ON A SWEPT, SUPERCRITICAL AIRFOIL: EVALUATION OF INITIAL PERFORATED CONFIGURATION
Charles D. Harris, Cuyler W. Brooks, Jr., Patricia G. Clukey, and John P. Stack Apr. 1992 125 p
(NASA-TM-4309; L-16856; NAS 1.15:4309) Avail: NTIS HC/MF A06 CSCL 01A

The initial evaluation of a large-chord, swept, supercritical airfoil incorporating an active laminar-flow-control (LFC) suction system with a perforated upper surface is documented in a chronological manner, and the deficiencies in the suction capability of the perforated panels as designed are described. The experiment was conducted in the Langley 8-Foot Transonic Pressure Tunnel. Also included is an evaluation of the influence of the proximity of the tunnel liner to the upper surface of the airfoil pressure distribution. Author

N92-22215*# Maryland Univ., College Park. Dept. of Aerospace Engineering.
HEAT TRANSFER CHARACTERISTICS OF HYPERSONIC WAVERIDERS WITH AN EMPHASIS ON THE LEADING EDGE EFFECTS M.S. Thesis, 1991
Denis O. Vanmol and John D. Anderson, Jr. Mar. 1992 126 p
(Grant NAG1-1192)
(NASA-CR-189586; NAS 1.26:189586; UM-AERO-91-42) Avail: NTIS HC/MF A07 CSCL 01A

The heat transfer characteristics in surface radiative equilibrium and the aerodynamic performance of blunted hypersonic waveriders are studied along two constant dynamic pressure trajectories for four different Mach numbers. The inviscid leading edge drag was found to be a small (4 to 8 percent) but not negligible fraction of the inviscid drag of the vehicle. Although the viscous drag at the leading edge can be neglected, the presence of the leading edge will influence the transition pattern of the upper and the lower surfaces and therefore affect the viscous drag of the entire vehicle. For an application similar to the National Aerospace Plane (NASP), the present study demonstrates that the waverider remains a

valuable concept at high Mach numbers if a state-of-the-art active cooling device is used along the leading edge. At low Mach number (less than 5), the study shows the surface radiative cooling might be sufficient. In all cases, radiative cooling is sufficient for the upper and lower surfaces of the vehicle if ceramic composites are used as thermal protection. Author

N92-22232*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXPERIMENTAL STUDY OF A GENERIC HIGH-SPEED CIVIL TRANSPORT: TABULATED DATA
Pamela S. Belton and Richard L. Campbell Mar. 1992 91 p
(NASA-TM-104216; NAS 1.15:104216) Avail: NTIS HC/MF A05 CSCL 01A

An experimental study of a generic high-speed civil transport was conducted in LaRC's 8-Foot Transonic Pressure Tunnel. The data base was obtained for the purpose of assessing the accuracy of various levels of computational analysis. Two models differing only in wing tip geometry were tested with and without flow-through nacelles. The baseline model has a curved or crescent wing tip shape while the second model has a more conventional straight wing tip shape. The study was conducted at Mach numbers from 0.30-1.19. Force data were obtained on both the straight and curved wing tip models. Only the curved wing tip model was instrumented for measuring pressures. Longitudinal and lateral-directional aerodynamic data are presented without analysis in tabulated form. Pressure coefficients for the curved wing tip model are also presented in tabulated form. Author

N92-22233# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Aerodynamics.
MODERNIZED MBB PANEL CODE: USER'S GUIDE INCLUDING BACKGROUND THEORY
E. Salminen 28 Aug. 1991 49 p
(PB92-136431; SER-B-91-B33; ISBN-951-22-0763-X) Avail: NTIS HC/MF A03 CSCL 01A

A modernized version of the MMB low-order panel method program written originally at the beginning of the 1970's is described. The new features of the combined version are the capability to read list-directed input, the capability to handle transpiration velocities through panel surfaces, and the capability to handle comment lines in an input file. The new version is also easier to use and easier to port to different types of machines than the original one. In addition to the combining process, the program was also linked to a specialized flow visualization program in order to expedite the pre- and post-processing. The link makes it possible to check the model and analyze the results using high-performance graphics workstations. Some DISSPLA-based plotting routines were also written for inspecting the model and representing the results on graphical terminals. A user's guide and a background theory are included. GRA

N92-22240*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FURTHER INVESTIGATIONS OF THE AEROELASTIC BEHAVIOR OF THE AFW WIND-TUNNEL MODEL USING TRANSONIC SMALL DISTURBANCE THEORY
Walter A. Silva and Robert M. Bennett Mar. 1992 12 p Presented at the Dynamics Specialists Conference, Dallas, TX, 16-17 Apr. 1992
(NASA-TM-107576; NAS 1.15:107576) Avail: NTIS HC/MF A03 CSCL 01A

The Computational Aeroelasticity Program-Transonic Small Disturbance (CAP-TSD) code, developed at LaRC, is applied to the active flexible wing wind-tunnel model for prediction of transonic aeroelastic behavior. A semi-span computational model is used for evaluation of symmetric motions, and a full-span model is used for evaluation of antisymmetric motions, and a full-span model is used for evaluation of antisymmetric motions. Static aeroelastic solutions using CAP-TSD are computed. Dynamic deformations are presented as flutter boundaries in terms of Mach number and dynamic pressure. Flutter boundaries that take into account modal refinements, vorticity and entropy corrections, antisymmetric motion, and sensitivity to the modeling of the wing tip ballast stores are also presented with experimental flutter results. Author

N92-22249*# Sverdrup Technology, Inc., Brook Park, OH.
THREE-DIMENSIONAL COMPRESSIBLE TURBULENT COMPUTATIONS FOR A DIFFUSING S-DUCT
C. F. Smith, J. E. Bruns, G. J. Harloff, and J. R. DeBonis Washington NASA Apr. 1992 37 p
(Contract NAS3-25266)
(NASA-CR-4392; E-6172; NAS 1.26:4392) Avail: NTIS HC/MF A03 CSCL 01A

The purpose of the present study was to evaluate the capability of the computational fluid dynamics computer program PARC3D to model flow in a typical diffusing subsonic S-duct, with strong secondary flows. This evaluation is needed to provide confidence in the analysis of aircraft inlets, which have similar geometries. The performance predictions include total pressure profiles, static pressures, velocity profiles, boundary layer data, and skin friction data. Flow in the S-duct is subsonic, and the boundary layers are assumed to be turbulent. The results for both H and O grid solutions, are compared with existing test data. Author

N92-22506*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FLOW FIELD OVER THE WING OF A DELTA-WING FIGHTER MODEL WITH VORTEX CONTROL DEVICES AT MACH 0.6 TO 1.2
E. Ann Bare, David E. Reubush, and Raymond C. Haddad (McDonnell-Douglas Corp., Saint Louis, MO.) Apr. 1992 126 p
(NASA-TM-4296; L-16834; NAS 1.15:4296) Avail: NTIS HC/MF A07 CSCL 01A

As part of a cooperative research program between NASA, McDonnell Douglas Corporation, and Wright Research and Development Center, a flow field investigation was conducted on a 7.52 percent scale windtunnel model of an advanced fighter aircraft design. The investigation was conducted in the Langley 16 ft Transonic Tunnel at Mach numbers of 0.6, 0.9, and 1.2. Angle of attack was varied from -4 degrees to 30 degrees and the model was tested at angles of sideslip of 0, 5, and -5 degrees. Data for the over the wing flow field were obtained at four axial survey stations by the use of six 5 hole conical probes mounted on a survey mechanism. The wing leading edge primary vortex exerted the greatest influence in terms of total pressure loss on the over the wing flow field in the area surveyed. A number of vortex control devices were also investigated. They included two different apex flaps, wing leading edge vortex flaps, and small large wing fences. The vortex flap and both apex flaps were beneficial in controlling the wing leading edge primary vortex. Author

N92-22507*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NACA0012 BENCHMARK MODEL EXPERIMENTAL FLUTTER RESULTS WITH UNSTEADY PRESSURE DISTRIBUTIONS
Jose A. Rivera, Jr., Bryan E. Dansberry, Robert M. Bennett, Michael H. Durham, and Walter A. Silva Mar. 1992 13 p Presented at the 33rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Dallas, TX, 13-15 Apr. 1992
(NASA-TM-107581; NAS 1.15:107581) Avail: NTIS HC/MF A03 CSCL 01A

The Structural Dynamics Division at NASA Langley Research Center has started a wind tunnel activity referred to as the Benchmark Models Program. The primary objective of this program is to acquire measured dynamic instability and corresponding pressure data that will be useful for developing and evaluating aeroelastic type computational fluid dynamics codes currently in use or under development. The program is a multi-year activity that will involve testing of several different models to investigate various aeroelastic phenomena. This paper describes results obtained from a second wind tunnel test of the first model in the Benchmark Models Program. This first model consisted of a rigid semispan wing having a rectangular planform and a NACA 0012

airfoil shape which was mounted on a flexible two degree of freedom mount system. Experimental flutter boundaries and corresponding unsteady pressure distribution data acquired over two model chords located at the 60 and 95 percent span stations are presented. Author

N92-22642*# Boeing Military Airplane Development, Seattle, WA.
PAN AIR: A COMPUTER PROGRAM FOR PREDICTING SUBSONIC OR SUPERSONIC LINEAR POTENTIAL FLOWS ABOUT ARBITRARY CONFIGURATIONS USING A HIGHER ORDER PANEL METHOD. VOLUME 4: MAINTENANCE DOCUMENT (VERSION 3.0) Report, Oct. 1984 - Sep. 1987
David J. Purdon, Pranab K. Baruah, John E. Bussoletti, Michael A. Epton, William A. Massena, Franklin D. Nelson, and Kiyoharu Tsurusaki Jan. 1990 883 p Sponsored in part by ASD; AFWAL; and Naval Coastal Systems Center
(Contract NAS2-12036)
(NASA-CR-3254; NAS 1.26:3254) Avail: NTIS HC/MF A99 CSCL 01A

The Maintenance Document Version 3.0 is a guide to the PAN AIR software system, a system which computes the subsonic or supersonic linear potential flow about a body of nearly arbitrary shape, using a higher order panel method. The document describes the overall system and each program module of the system. Sufficient detail is given for program maintenance, updating, and modification. It is assumed that the reader is familiar with programming and CRAY computer systems. The PAN AIR system was written in FORTRAN 4 language except for a few CAL language subroutines which exist in the PAN AIR library. Structured programming techniques were used to provide code documentation and maintainability. The operating systems accommodated are COS 1.11, COS 1.12, COS 1.13, and COS 1.14 on the CRAY 1S, 1M, and X-MP computing systems. The system is comprised of a data base management system, a program library, an execution control module, and nine separate FORTRAN technical modules. Each module calculates part of the posed PAN AIR problem. The data base manager is used to communicate between modules and within modules. The technical modules must be run in a prescribed fashion for each PAN AIR problem. In order to ease the problem of supplying the many JCL cards required to execute the modules, a set of CRAY procedures (PAPROCS) was created to automatically supply most of the JCL cards. Most of this document has not changed for Version 3.0. It now, however, strictly applies only to PAN AIR version 3.0. The major changes are: (1) additional sections covering the new FDP module (which calculates streamlines and offbody points); (2) a complete rewrite of the section on the MAG module; and (3) strict applicability to CRAY computing systems. Author

N92-22648*# Boeing Computer Services Co., Seattle, WA.
PAN AIR: A COMPUTER PROGRAM FOR PREDICTING SUBSONIC OR SUPERSONIC LINEAR POTENTIAL FLOWS ABOUT ARBITRARY CONFIGURATIONS USING A HIGHER ORDER PANEL METHOD. VOLUME 1: THEORY DOCUMENT (VERSION 3.0) Report, Oct. 1984 - Sep. 1987
Michael A. Epton and Alfred E. Magnus 1990 599 p Revised Sponsored in part by ASD; AFWAL; and Naval Coastal Systems Center
(Contract NAS2-12036)
(NASA-CR-3251; NAS 1.26:3251) Avail: NTIS HC/MF A25 CSCL 01A

An outline of the derivation of the differential equation governing linear subsonic and supersonic potential flow is given. The use of Green's Theorem to obtain an integral equation over the boundary surface is discussed. The engineering techniques incorporated in the Panel Aerodynamics (PAN AIR) program (a discretization method which solves the integral equation for arbitrary first order boundary conditions) are then discussed in detail. Items discussed include the construction of the compressibility transformation, splining techniques, imposition of the boundary conditions, influence coefficient computation (including the concept of the finite part of an integral), computation of pressure coefficients, and computation of forces and moments. Principal revisions to version 3.0 are the following: (1) appendices H and K more fully describe the Aerodynamic Influence Coefficient (AIC) construction; (2) appendix L now provides a complete description of the AIC solution process; (3) appendix P is new and discusses the theory for the new FDP module (which calculates streamlines and offbody points); and (4) numerous small corrections and revisions reflecting the MAG module rewrite. Author

N92-22865*# Boeing Military Airplane Development, Seattle, WA.
PAN AIR: A COMPUTER PROGRAM FOR PREDICTING SUBSONIC OR SUPERSONIC LINEAR POTENTIAL FLOWS ABOUT ARBITRARY CONFIGURATIONS USING A HIGHER ORDER PANEL METHOD. VOLUME 2: USER'S MANUAL (VERSION 3.0) Report, Oct. 1984 - Sep. 1987
Kenneth W. Sidwell, Pranab K. Baruah, John E. Bussoletti, Richard T. Medan, R. S. Conner, and David J. Purdon 1990 834 p Revised Sponsored in part by ASD; AFWAL; and Naval Coastal Systems Center
(Contract NAS2-12036)
(NASA-CR-3252; NAS 1.26:3252) Avail: NTIS HC/MF A99 CSCL 01A

A comprehensive description of user problem definition for the PAN AIR (Panel Aerodynamics) system is given. PAN AIR solves the 3-D linear integral equations of subsonic and supersonic flow. Influence coefficient methods are used which employ source and doublet panels as boundary surfaces. Both analysis and design boundary conditions can be used. This User's Manual describes the information needed to use the PAN AIR system. The structure and organization of PAN AIR are described, including the job control and module execution control languages for execution of the program system. The engineering input data are described, including the mathematical and physical modeling requirements. Version 3.0 strictly applies only to PAN AIR version 3.0. The major revisions include: (1) inputs and guidelines for the new FDP module (which calculates streamlines and offbody points); (2) nine new class 1 and class 2 boundary conditions to cover commonly used modeling practices, in particular the vorticity matching Kutta condition; (3) use of the CRAY solid state Storage Device (SSD); and (4) incorporation of errata and typo's together with additional explanation and guidelines. Author

N92-23095*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STATIC PERFORMANCE OF A CRUCIFORM NOZZLE WITH MULTIAXIS THRUST-VECTORING AND REVERSE-THRUST CAPABILITIES
David J. Wing and Scott C. Asbury Apr. 1992 82 p
(NASA-TP-3188; L-16958; NAS 1.60:3188) Avail: NTIS HC/MF A05 CSCL 01A

A multiaxis thrust vectoring nozzle designed to have equal flow turning capability in pitch and yaw was conceived and experimentally tested for internal, static performance. The cruciform-shaped convergent-divergent nozzle turned the flow for thrust vectoring by deflecting the divergent surfaces of the nozzle, called flaps. Methods for eliminating physical interference between pitch and yaw flaps at the larger multiaxis deflection angles was studied. These methods included restricting the pitch flaps from the path of the yaw flaps and shifting the flow path at the throat off the nozzle centerline to permit larger pitch-flap deflections without interfering with the operation of the yaw flaps. Two flap widths were tested at both dry and afterburning settings. Vertical and reverse thrust configurations at dry power were also tested. Comparison with two dimensional convergent-divergent nozzles showed lower but still competitive thrust performance and thrust vectoring capability. Author

N92-23103*# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.
HIGH SPEED TRANSPORT CRUISE DRAG
Leonard Roberts Apr. 1992 12 p

(NASA-CR-190248; NAS 1.26:190248; JIAA-TR-106) Avail: NTIS HC/MF A03 CSCL 01A

This report provides scaling laws for the cruise aerodynamics of high speed transport wings based on the results of Navier-Stokes computations. Expressions for the various drag components are found, together with the corresponding values (L/D)(sub m) for various values of the geometric parameter s/l which allow for simple optimization of the wing configurations with respect to the span. It is found that linear theory expressions can be used for this purpose provided the coefficients of these experiments for C(sub D) and (L/D)(sub m) are available using Navier-Stokes results. Author

N92-23105*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

NASA'S AIRCRAFT ICING TECHNOLOGY PROGRAM

John J. Reinmann 1991 12 p Presented at the 1991 Winter Annual Meeting of the ASME, Atlanta, GA, 1-6 Dec. 1991 Previously announced as N91-20120

(NASA-TM-104518; E-6388; NAS 1.15:104518) Avail: NTIS HC/MF A03 CSCL 01A

NASA' Aircraft Icing Technology program is aimed at developing innovative technologies for safe and efficient flight into forecasted icing. The program addresses the needs of all aircraft classes and supports both commercial and military applications. The program is guided by three key strategic objectives: (1) numerically simulate an aircraft's response to an in-flight icing encounter, (2) provide improved experimental icing simulation facilities and testing techniques, and (3) offer innovative approaches to ice protection. Our research focuses on topics that directly support stated industry needs, and we work closely with industry to assure a rapid and smooth transfer of technology. This paper presents selected results that illustrate progress towards the three strategic objectives, and it provides a comprehensive list of references on the NASA icing program. Author

N92-23116*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THREE-DIMENSIONAL TIME-MARCHING AEROELASTIC ANALYSES USING AN UNSTRUCTURED-GRID EULER METHOD

Russ D. Rausch, John T. Batina, and Henry T. Y. Yang (Purdue Univ., West Lafayette, IN.) Mar. 1992 13 p Presented at the 33d AIAA, ASME, ASCE, AHS, ASC Structures, Structural Dynamics and Materials Conference, Dallas, TX, 13-15 Apr. 1992

(NASA-TM-107567; NAS 1.15:107567) Avail: NTIS HC/MF A03 CSCL 01A

Modifications to a three dimensional, implicit, upwind, unstructured-grid Euler code for aeroelastic analysis of complete aircraft configurations are described. The modifications involve the addition of the structural equations of motion for their simultaneous time integration with the governing flow equations. The paper presents a detailed description of the time marching aeroelastic procedure and presents comparisons with experimental data to provide an assessment of the capability. Flutter results are shown for an isolated 45 degree swept-back wing and a supersonic transport configuration with a fuselage, clipped delta wing, and two identical rearward-mounted nacelles. Comparisons between computed and experimental flutter characteristics show good agreement, giving confidence in the accuracy of the aeroelastic capability that was developed. Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-22408# Loughborough Univ. of Technology (England). Dept. of Electrical and Electronic Engineering.

AN INVESTIGATION INTO THE FEASIBILITY OF PROVIDING A PROXIMITY WARNING DEVICE FOR SEARCH AND RESCUE HELICOPTERS M.S. Thesis

R. M. Adams 1990 132 p Prepared in cooperation with Royal Air Force Coll., Cranwell, England

(ETN-92-91057) Copyright Avail: NTIS HC/MF A07

An investigation and system feasibility analysis for the design of a rotor blade proximity warning facility for helicopters operating at slow speeds and in hover in poor visibility and weather conditions is presented. To achieve this, sensor options operating over the microwave to electrooptic frequencies are considered for their suitability to resolve low radar cross section targets in range, velocity, and azimuth displacement. The optimum system is deduced from the abilities of various strategies, their practical limitations and the available technology. The requirement of an active or passive system, the choice of wavelength, fundamental radar principle to be applied, and the anticipated performance estimation based on the radar range equation are addressed. ESA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-22104# Mitre Corp., Bedford, MA.

TECHNICAL FEASIBILITY OF DIGITAL THREE-DIMENSIONAL CELLULAR COMMUNICATIONS FOR AIR TRAFFIC CONTROL APPLICATIONS. VOLUME 1: INTRODUCTION AND SUMMARY

B. E. White, M. Leiter, R. I. Millar, J. L. Ramsey, and R. D. Sakamoto Dec. 1991 42 p

(AD-A244573; M91-122-Vol-1) Avail: NTIS HC/MF A03 CSCL 25/4

MITRE's Center for Advanced Aviation System Development (CAASD) has proposed a set of concepts for improving VHF communications for air traffic control applications. One idea, called CTAG for Cellular Trunked Air Ground (CTAG) communications is to extend land-mobile cellular-trunked digital communications technology to air-ground communication between pilots and controllers. This study was aimed at addressing the technical feasibility of this approach. Detailed results show that significant benefits can indeed be obtained in not only automating routine communications functions but also in reducing the number of frequency channels required compared with existing analog voice-only procedures. Further work is required to quantify potential system costs, particularly those associated with the ground portions of the CTAG network. Author (GRA)

N92-22105# Mitre Corp., Bedford, MA.

TECHNICAL FEASIBILITY OF DIGITAL THREE-DIMENSIONAL CELLULAR COMMUNICATIONS FOR AIR TRAFFIC CONTROL APPLICATIONS. VOLUME 2: EXAMPLE SYSTEM DESIGN DETAILS

M. Leiter, R. I. Millar, J. L. Ramsey, B. E. White, and W. J. Wilson Dec. 1991 138 p

(AD-A244574; M91-122-Vol-2) Avail: NTIS HC/MF A07 CSCL 25/4

MITRE's Center for Advanced Aviation System Development (CAASD) has proposed a set of concepts for improving VHF communications for air traffic control applications. One idea, called CTAG for Cellular Trunked Air Ground (CTAG) communications is to extend land-mobile cellular-trunked digital communications technology to air-ground communication between pilots and controllers. This study was aimed at addressing the technical feasibility of this approach. Detailed results show that significant benefits can indeed be obtained in not only automating routine communications functions but also in reducing the number of frequency channels required compared with existing analog voice-only procedures. Further work is required to quantify potential system costs, particularly those associated with the ground portions of the CTAG network. Author (GRA)

N92-22106# Mitre Corp., Bedford, MA.
TECHNICAL FEASIBILITY OF DIGITAL THREE-DIMENSIONAL CELLULAR COMMUNICATIONS FOR AIR TRAFFIC CONTROL APPLICATIONS. VOLUME 3: GROUND NETWORK ARCHITECTURE
M. Leiter, R. I. Millar, J. L. Ramsey, R. D. Sakamotor, and B. E. White Dec. 1991 51 p
(AD-A244575; M91-122-Vol-3) Avail: NTIS HC/MF A04 CSCL 25/4

MITRE's Center for Advanced Aviation System Development (CAASD) has proposed a set of concepts for improving VHF communications for air traffic control applications. One idea, called CTAG for Cellular Trunked Air Ground (CTAG) communications is to extend land-mobile cellular-trunked digital communications technology to air-ground communication between pilots and controllers. This study was aimed at addressing the technical feasibility of this approach. Detailed results show that significant benefits can indeed be obtained in not only automating routine communications functions but also in reducing the number of frequency channels required compared with existing analog voice-only procedures. Further work is required to quantify potential system costs, particularly those associated with the ground portions of the CTAG network. GRA

N92-22210# Federal Aviation Administration, Atlantic City, NJ.
COMPARISON OF THE PERFORMANCE OF A MICROWAVE LANDING SYSTEM ELEVATION STATION WITH THE INSTRUMENT LANDING SYSTEM END-FIRE GLIDE SLOPE AT YEAGER AIRPORT, CHARLESTON, WEST VIRGINIA Technical Report, Apr. 1991
Clifford Mackin and Edmund Zyzys Mar. 1992 28 p
(Contract FAA-T0604-S)
(DOT/FAA/CT-TN91/22; ACD-330) Avail: NTIS HC/MF A03

A comparison is made between microwave landing systems (MLS) and instrument landing systems (ILS) by installing an MLS elevation station collocated with the ILS basic end-fire glide slope (EFGS) on a runway. The EFGS is the only type of ILS glide slope antenna that will provide operationally usable performance at the site because of limited flat terrain in front of the antenna and a valley with hills in approach to the runway. The MLS testbed, consisting of a 1.5 degree beamwidth elevation station and a 2 degree beamwidth azimuth station, was transported to and installed at Yeager Airport on runway 23. The MLS station did not affect the performance of the ILS station as verified by a flight check. During ground tracked partial orbits and inbound level runs and approaches, Both ILS and MLS data were simultaneously recorded. The MLS data showed improved performance over the ILS based on EFGS. Author

N92-22389# National Aeronautical Lab., Bangalore (India).
PC BASED FLIGHT PATH RECONSTRUCTION USING UD FACTORIZATION FILTERING ALGORITHM
Girija Gopalratnam and J. R. Raol Feb. 1992 36 p
(NAL-PD-FC-9201) Avail: NTIS HC/MF A03

Described here are the results of a UD based flight path reconstruction algorithm implemented using PC-MATLAB. It is validated using simulated and real data for linear and nonlinear systems. The bounds on states and parameters are also given. Author

N92-23096# Computer Resource Management, Inc., Herndon, VA.
NATIONAL AIRSPACE SYSTEM: SYSTEM EFFECTIVENESS OPERATIONAL CONCEPT NAS-SR-138
William Trent, Thomas Pickerell, and Harold Nelson, Jr. Apr. 1992 48 p
(Contract DTFA01-91-Y-01004)
(DOT/FAA/SE-92/2) Avail: NTIS HC/MF A03

A requirement for the National Airspace System (NAS) is to provide for system effectiveness as identified in the NAS Systems Requirements Specifications (NASSRS). This operational concept will describe the operation of the NAS when the projected upgrade is complete (i.e., 'end state'). These documents will assist in linking the requirements specified in the NASSRS with the NAS design. This concept and seven other operational concepts will complete the description of the system requirements as described in the NASSRS. Author

N92-22436*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
GLOBAL POSITIONING SYSTEM SUPPORTED PILOT'S DISPLAY
Marshall M. Scott, Jr., Temel Erdogan, Andrew P. Schwalb, and Charles H. Curley (Boeing Aerospace Co., Kennedy Space Center, FL.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 101-108 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17G

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N92-22605 Virginia Polytechnic Inst. and State Univ., Blacksburg.
TIME-OPTIMAL REORIENTATION MANEUVERS OF AN AIRCRAFT Ph.D. Thesis
Spiro Bocvarov 1991 130 p
Avail: Univ. Microfilms Order No. DA9204627

The problem of time optimal fuselage reorientation maneuvering of a combat aircraft, with and without thrust vectoring capability, was analyzed. An accurate mathematical model for the reorientation maneuvers of interest was developed, to ensure practical value of the analysis. In particular, an effective method for smooth fitting of the aerodynamic data was devised. The Minimum Principle from optimal control theory was applied and the optimal control problems of interest cast into a form of numerical multipoint boundary value problems. These are extremely difficult to solve. To alleviate their treatment, a hybrid approach was adopted. Homotopy ideas were combined with comprehensive analyses of the structure of the dynamical equations and engineering insight into the mechanics of the reorientation motions. The approach successfully yielded a number of extremal solutions for a few typical reorientation maneuvers. The nature and essential characteristics of the extremal motions were understood, as well as their domains of existence. A few parametric studies showed how aircraft design parameters should be tailored to allow for improved maneuverability. Dissert. Abstr.

N92-22785# European Office of Aerospace Research and Development, FPO New York, NY.
REPORT ON AEROSPACE STRUCTURES AND STRUCTURAL MATERIALS R AND D IN EUROPE

J. G. R. Hansen Oct. 1990 46 p
(PB92-123553; EOARD-LR-91-008) Avail: NTIS HC/MF A03 CSCL 01C

The end-of-tour report summarizes 65 leading European R&D programs encountered by the author during his assignment as Chief, Structures and Structural Materials in the USAF EOARD (European Office of Aerospace Research and Development) from 1985 to 1990. There are two sections: (1) Aerospace Structural Materials; and (2) Aerospace Structures and Solid Mechanics. For each of the program, a summary of the capability is presented, contact information is provided for the principal investigator, other more detailed EOARD Liaison Reports (which can be ordered from EOARD) are referenced if they exist, and if there has been an R&D project funded by the USAF at the European organization, the name and address of the USAF project monitor is provided.
Author

N92-22864*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
WING FORCE AND SURFACE PRESSURE DATA FROM A HOVER TEST OF A 0.658-SCALE V-22 ROTOR AND WING
Fort F. Felker, Patrick R. Shinoda, Ruth M. Heffernan, and Hugh F. Sheehy Feb. 1990 221 p
(NASA-TM-102244; A-89267; NAS 1.15:102244) Avail: NTIS HC/MF A10 CSCL 01C

A hover test of a 0.658-scale V-22 rotor and wing was conducted in the 40 x 80 foot wind tunnel at Ames Research Center. The principal objective of the test was to measure the surface pressures and total download on a large scale V-22 wing in hover. The test configuration consisted of a single rotor and semispan wing on independent balance systems. A large image plane was used to represent the aircraft plane of symmetry. Wing flap angles ranging from 45 to 90 degrees were examined. Data were acquired for both directions of the rotor rotation relative to the wing. Steady and unsteady wing surface pressures, total wing forces, and rotor performance data are presented for all of the configurations that were tested.
Author

N92-22534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE NASA AIRCRAFT ICING RESEARCH PROGRAM
Robert J. Shaw and John J. Reinmann *In its* Aeropropulsion 1987 Feb. 1990 p 315-341 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N92-22395*# Computer Sciences Corp., Hampton, VA.
ADVANCED TRANSPORT OPERATING SYSTEM (ATOPS) COLOR DISPLAYS SOFTWARE DESCRIPTION: MICROVAX SYSTEM
Christopher J. Slominski, Valerie E. Plyler, and Richard W. Dickson Jan. 1992 266 p
(Contract NAS1-19038)
(NASA-CR-189603; NAS 1.26:189603) Avail: NTIS HC/MF A12 CSCL 01D

This document describes the software created for the Display MicroVAX computer used for the Advanced Transport Operating Systems (ATOPS) project on the Transport Systems Research Vehicle (TSRV). The software delivery of February 27, 1991, known as the 'baseline display system', is the one described in this document. Throughout this publication, module descriptions are presented in a standardized format which contains module purpose, calling sequence, detailed description, and global references. The global references section includes subroutines, functions, and common variables referenced by a particular module. The system described supports the Research Flight Deck (RFD) of the TSRV. The RFD contains eight Cathode Ray Tubes (CRTs) which depict a Primary Flight Display, Navigation Display, System Warning Display, Takeoff Performance Monitoring System Display, and Engine Display.
Author

N92-22504*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A GRAPHICAL WEATHER SYSTEM DESIGN FOR THE NASA TRANSPORT SYSTEMS RESEARCH VEHICLE B-737
Charles H. Scanlon Feb. 1992 19 p Original contains color illustrations
(NASA-TM-104205; NAS 1.15:104205) Avail: NTIS HC/MF A03; 6 functional color pages CSCL 01D

A graphical weather system was designed for testing in the NASA Transport Systems Research Vehicle B-737 airplane and simulator. The purpose of these tests was to measure the impact of graphical weather products on aircrew decision processes, weather situation awareness, reroute clearances, workload, and weather monitoring. The flight crew graphical weather interface is described along with integration of the weather system with the flight navigation system, and data link transmission methods for sending weather data to the airplane.
Author

N92-22645*# Computer Sciences Corp., Hampton, VA.
ADVANCED TRANSPORT OPERATING SYSTEM (ATOPS) COLOR DISPLAYS SOFTWARE DESCRIPTION MICROPROCESSOR SYSTEM
Christopher J. Slominski, Valerie E. Plyler, and Richard W. Dickson Jan. 1992 291 p
(Contract NAS1-19038)
(NASA-CR-189605; NAS 1.26:189605) Avail: NTIS HC/MF A13 CSCL 01D

This document describes the software created for the Sperry Microprocessor Color Display System used for the Advanced Transport Operating Systems (ATOPS) project on the Transport Systems Research Vehicle (TSRV). The software delivery known as the 'baseline display system', is the one described in this document. Throughout this publication, module descriptions are presented in a standardized format which contains module purpose, calling sequence, detailed description, and global references. The global reference section includes procedures and common variables referenced by a particular module. The system described supports the Research Flight Deck (RFD) of the TSRV. The RFD contains eight cathode ray tubes (CRTs) which depict a Primary Flight Display, Navigation Display, System Warning Display, Takeoff Performance Monitoring System Display, and Engine Display.
Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-22098# Rolls-Royce Ltd., Derby (England).
IMPACT OF REGULATION CHANGES ON ENGINE DESIGN AND CERTIFICATION
C. G. Cant 1 Nov. 1990 16 p
(PNR-90789; ETN-92-90843) Copyright Avail: NTIS HC/MF A03

Some changes to the airworthiness regulations can have a major effect on the engine manufacturer. An example of such an effect was the enforced cessation of Civil Spey engine new production resulting from the introduction of the FAR Part 36 Stage 3 Noise rule. The resultant evolution of the Tay engine, initially conceived to power the Fokker F100 aircraft is traced and some

of the design features and resulting engine certification test aspects are described. ESA

N92-22406# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
AIRCRAFT GAS TURBINE EMISSIONS: THEIR NATURE, TECHNOLOGY FOR REDUCTION, AND A POLLUTION COMPARISON WITH CHANNEL TUNNEL TRANSPORT M.S. Thesis
P. J. Heard 1990 237 p Sponsored by Ministry of Defence Prepared in cooperation with Royal Air Force Coll., Cranwell, England
(ETN-92-91056) Copyright Avail: NTIS HC/MF A11

The techniques and technologies involved in reducing exhaust emission levels from aircraft gas turbine engines are examined and current pollution levels are compared with other modes of transport. The nature of gas turbine emissions and the available technology for reducing emission levels are discussed. A pollution comparison in traveling from London to Paris by air and via the Channel Tunnel is made. The first two routes compared were by air and by the through train from Waterloo to Paris (Gare du Nord Station); both of these routes offer journey times of approximately three hours and would therefore compete for a similar market. The entire rail network will be electrified between the two capitals, and hence the power station emissions produced in providing the energy to move the strains was included. With the exception of sulphur dioxide emissions (produced from power stations), the emissions per passenger in traveling by train are substantially lower than going by air. To complete the study, a third route was examined. This route is by petrol vehicle utilizing the Tunnel Shuttle. Comparisons of the emissions per passenger illustrated that travelling by car is the most damaging form of transport in terms of effect on the environment. ESA

N92-22510*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AEROPROPULSION 1987
Washington Feb. 1990 498 p Conference held in Cleveland, OH, 17-19 Nov. 1987 Previously announced as N88-16697, N88-15785, N88-15790, N88-15794, N88-15800 and N88-15807 (NASA-CP-3049; E-3798; NAS 1.55:3049) Avail: NTIS HC/MF A21 CSCL 21E

Papers from the Aeropropulsion '87 Conference, held at the NASA Lewis Research Center (LeRC), are presented. Unclassified presentations by LeRC and NASA Headquarters senior management and many LeRC technical authors covered the philosophy and major directions of the LeRC aeropropulsion program, and presented a broad spectrum of recent research results in materials, structures, internal fluid mechanics, instrumentation and controls, and both subsonic and high-speed propulsion technology. For individual titles, see N92-22511 through N92-22543.

N92-22511*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPACT AND PROMISE OF NASA AEROPROPULSION TECHNOLOGY
Neal T. Saunders and David N. Bowditch *In its* Aeropropulsion 1987 Feb. 1990 p 13-36 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

The aeropropulsion industry in the U.S. has established an enviable record of leading the world in aeropropulsion for commercial and military aircraft. NASA's aeropropulsion program (primarily conducted through the Lewis Research Center) has significantly contributed to that success through research and technology advances and technology demonstration. Some past NASA contributions to engines in current aircraft are reviewed, and technologies emerging from current research programs for the aircraft of the 1990's are described. Finally, current program thrusts toward improving propulsion systems in the 2000's for subsonic commercial aircraft and higher speed aircraft such as the High-Speed Civil Transport and the National Aerospace Plane are discussed. D.R.D.

N92-22512*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA. LEWIS RESEARCH CENTER MATERIALS RESEARCH AND TECHNOLOGY: AN OVERVIEW
Salvatore J. Grisaffe *In its* Aeropropulsion 1987 Feb. 1990 p 37-44 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

The Materials Division at the Lewis Research Center has a long record of contributions to both materials and process technology as well as to the understanding of key high-temperature phenomena. This paper overviews the division staff, facilities, past history, recent progress, and future interests. D.R.D.

N92-22513*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE POLYMER MATRIX COMPOSITES c24
Michael A. Meador *In its* Aeropropulsion 1987 Feb. 1990 p 45-54 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11D

Polymers research at the NASA Lewis Research Center has produced high-temperature, easily processable resin systems, such as PMR-15. In addition, the Polymers Branch has investigated ways to improve the mechanical properties of polymers and the microcracking resistance of polymer matrix composites in response to industry need for new and improved aeropropulsion materials. Current and future research in the Polymers Branch is aimed at advancing the upper use temperature of polymer matrix composites to 700 F and beyond by developing new resins, by examining the use of fiber reinforcements other than graphite, and by developing coatings for polymer matrix composites to increase their oxidation resistance. D.R.D.

N92-22514*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CREEP AND FATIGUE RESEARCH EFFORTS ON ADVANCED MATERIALS c39
John Gayda *In its* Aeropropulsion 1987 Feb. 1990 p 55-63 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20K

Two of the more important materials problems encountered in turbine blades of aircraft engines are creep and fatigue. To withstand these high-temperature phenomena, modern engines utilize single-crystal, nickel-base superalloys as the material of choice in critical applications. This paper will present recent research activities at NASA's Lewis Research Center on single-crystal blading material, related to creep and fatigue. The goal of these research efforts is to improve the understanding of microstructure-property relationships and thereby guide material development. D.R.D.

N92-22515*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF A NEW GENERATION OF HIGH-TEMPERATURE COMPOSITE MATERIALS c24
P. K. Brindley *In its* Aeropropulsion 1987 Feb. 1990 p 65-78 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11D

Intermetallic matrix composites proposed to meet advanced aeropropulsion requirements are discussed. The powder metallurgy fabrication process currently being used to produce these intermetallic matrix composites will be presented, as will properties of one such composite, SiC/Ti3Al+Nb. In addition, the direction of future research will be outlined, including plans for enhanced fabrication of intermetallic composites by the arc-spray technique and fiber development by the floating-zone process. D.R.D.

N92-22516*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SELF-LUBRICATING COATINGS FOR HIGH-TEMPERATURE APPLICATIONS c27

Harold E. Sliney *In its* Aeropropulsion 1987 Feb. 1990 p 79-90 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11C

Solid lubricants with maximum temperature capabilities of about 1100 C are known. Unfortunately, none of the solid lubricants with the highest temperature capabilities are effective below 400 C. However, research at NASA's Lewis Research Center shows that silver and stable fluorides such as calcium and barium fluorides act synergistically to provide lubrication from below room temperature to about 900 C. This paper describes plasma-sprayed composite coatings that contain these solid lubricants in combination with a metal-bonded chromium carbide. The lubricants control friction, and the carbide matrix provides wear resistance. Successful tests of these coatings as backup lubricants for compliant gas bearings in turbomachinery and as self-lubricating liners in a four-cylinder Stirling engine are discussed. D.R.D.

N92-22517*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CERAMICS FOR ENGINES **c27**
James D. Kiser, Stanley R. Levine, and James A. DiCarlo *In its* Aeropropulsion 1987 Feb. 1990 p 91-103 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11C

The NASA Lewis Research Center's Ceramic Technology Program is focused on aerospace propulsion and power needs. Thus, emphasis is on high-temperature ceramics and their structural and environmental durability and reliability. The program is interdisciplinary in nature with major emphasis on materials and processing, but with significant efforts in design methodology and life prediction. D.R.D.

N92-22518*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AEROPROPULSION STRUCTURES
Lester D. Nichols *In its* Aeropropulsion 1987 Feb. 1990 p 105-111 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Aeropropulsion systems present unique problems to the structural engineer. The extremes in operating temperatures, rotational effects, and behaviors of advance material systems combine into complexities that require advances in many scientific disciplines involved in structural analysis and design procedures. This paper provides an overview of the complexities of aeropropulsion structures and the theoretical, computational, and experimental research conducted to achieve the needed advances. D.R.D.

N92-22519*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DETERMINING STRUCTURAL PERFORMANCE
Michael A. Ernst, ed., Gerald Brown, Eliseo DiRusso, David Fleming, David Janetzke, Albert Kascak, Krishna Kaza, Robert Kielb, Louis J. Kiraly, and Charles Lawrence et al *In its* Aeropropulsion 1987 Feb. 1990 p 113-128 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

An overview of the methods and concepts developed to enhance and predict structural dynamic characteristics of advanced aeropropulsion systems is presented. Aeroelasticity, vibration control, dynamic systems, and computational structural methods are four disciplines that make up the structural dynamic effort at LeRC. The aeroelasticity program develops analytical and experimental methods for minimizing flutter and forced vibration of aerospace propulsion systems. Both frequency domain and time domain methods were developed for applications on the turbofan, turbopump, and advanced turboprop. In order to improve life and performance, the vibration control program conceives, analyzes, develops, and demonstrates new methods for controlling vibrations in aerospace systems. Active and passive vibration control is accomplished with electromagnetic dampers, magnetic bearings, and piezoelectric crystals to control rotor vibrations. The dynamic systems program analyzes and verifies the dynamics of interacting systems, as well as develops concepts and methods for high-temperature dynamic seals. Work in this field involves the analysis and parametric identification of large, nonlinear, damped, stochastic systems. The computational structural methods program exploits modern computer science as an aid to the solutions of structural problems. Author

N92-22520*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LIFE PREDICTION TECHNOLOGIES FOR AERONAUTICAL PROPULSION SYSTEMS
Michael A. McGaw *In its* Aeropropulsion 1987 Feb. 1990 p 129-139 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Fatigue and fracture problems continue to occur in aeronautical gas turbine engines. Components whose useful life is limited by these failure modes include turbine hot-section blades, vanes, and disks. Safety considerations dictate that catastrophic failures be avoided, while economic considerations dictate that catastrophic failures be avoided, while economic considerations dictate that noncatastrophic failures occur as infrequently as possible. Therefore, the decision in design is making the tradeoff between engine performance and durability. LeRC has contributed to the aeropropulsion industry in the area of life prediction technology for over 30 years, developing creep and fatigue life prediction methodologies for hot-section materials. At the present time, emphasis is being placed on the development of methods capable of handling both thermal and mechanical fatigue under severe environments. Recent accomplishments include the development of more accurate creep-fatigue life prediction methods such as the total strain version of LeRC's strain-range partitioning (SRP) and the HOST-developed cyclic damage accumulation (CDA) model. Other examples include the development of a more accurate cumulative fatigue damage rule - the double damage curve approach (DDCA), which provides greatly improved accuracy in comparison with usual cumulative fatigue design rules. Other accomplishments in the area of high-temperature fatigue crack growth may also be mentioned. Finally, we are looking to the future and are beginning to do research on the advanced methods which will be required for development of advanced materials and propulsion systems over the next 10-20 years. Author

N92-22521*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTEGRATED ANALYSIS AND APPLICATIONS
Dale A. Hopkins *In its* Aeropropulsion 1987 Feb. 1990 p 141-153 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

An overview is presented of current research activities which, in a broad context, are focused on the development and verification of integrated structural analysis and optimal design capabilities for advanced aerospace propulsion and power systems. The overview encompasses a variety of subject areas including: (1) composite materials; (2) advanced structural analysis; (3) constitutive modeling; (4) computational simulation; (5) probabilistic analysis; and (6) multidisciplinary optimization. Typical results are presented which illustrate the benefit and utility of the emerging technologies as applied to propulsion and power system structures. K.S.

N92-22522*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTRODUCTION TO THE INTERNAL FLUID MECHANICS RESEARCH SESSION Abstract Only **c34**
Brent A. Miller and Louis A. Povinelli *In its* Aeropropulsion 1987 Feb. 1990 p 155 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

Internal fluid mechanics research at LeRC is directed toward an improved understanding of the important flow physics affecting aerospace propulsion systems, and applying this improved understanding to formulate accurate predictive codes. To this end, research is conducted involving detailed experimentation and analysis. The following three papers summarize ongoing work and

indicate future emphasis in three major research thrusts: inlets, ducts, and nozzles; turbomachinery; and chemical reacting flows. The underlying goal of the research in each of these areas is to bring internal computational fluid mechanic to a state of practical application for aerospace propulsion systems. Achievement of this goal requires that carefully planned and executed experiments be conducted in order to develop and validate useful codes. It is critical that numerical code development work and experimental work be closely coupled. The insights gained are represented by mathematical models that form the basis for code development. The resultant codes are then tested by comparing them with appropriate experiments in order to ensure their validity and determine their applicable range. The ultimate user community must be a part of this process to assure relevancy of the work and to hasten its practical application. Propulsion systems are characterized by highly complex and dynamic internal flows. Many complex, 3-D flow phenomena may be present, including unsteadiness, shocks, and chemical reactions. By focusing on specific portions of a propulsion system, it is often possible to identify the dominant phenomena that must be understood and modeled for obtaining accurate predictive capability. The three major research thrusts serve as a focus leading to greater understanding of the relevant physics and to an improvement in analytic tools. This in turn will hasten continued advancements in propulsion system performance and capability. Author

N92-22523*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INLETS, DUCTS, AND NOZZLES **c34**
John M. Abbott, Bernhard H. Anderson, and Edward J. Rice *In its* Aeropropulsion 1987 Feb. 1990 p 157-174 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

The internal fluid mechanics research program in inlets, ducts, and nozzles consists of a balanced effort between the development of computational tools (both parabolized Navier-Stokes and full Navier-Stokes) and the conduct of experimental research. The experiments are designed to better understand the fluid flow physics, to develop new or improved flow models, and to provide benchmark quality data sets for validation of the computational methods. The inlet, duct, and nozzle research program is described according to three major classifications of flow phenomena: (1) highly 3-D flow fields; (2) shock-boundary-layer interactions; and (3) shear layer control. Specific examples of current and future elements of the research program are described for each of these phenomenon. In particular, the highly 3-D flow field phenomenon is highlighted by describing the computational and experimental research program in transition ducts having a round-to-rectangular area variation. In the case of shock-boundary-layer interactions, the specific details of research for normal shock-boundary-layer interactions are described. For shear layer control, research in vortex generators and the use of aerodynamic excitation for enhancement of the jet mixing process are described. Author

N92-22524*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TURBOMACHINERY
Robert J. Simoneau, Anthony J. Strazisar, Peter M. Sockol, Lonnie Reid, and John J. Adamczyk *In its* Aeropropulsion 1987 Feb. 1990 p 175-195 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

The discipline research in turbomachinery, which is directed toward building the tools needed to understand such a complex flow phenomenon, is based on the fact that flow in turbomachinery is fundamentally unsteady or time dependent. Success in building a reliable inventory of analytic and experimental tools will depend on how we treat time and time-averages, as well as how we treat space and space-averages. The challenge is to develop a set of computational and experimental tools which genuinely increase our understanding of the fluid flow and heat transfer in a turbomachine. Examples of the types of computational and experimental tools under current development, with progress to date, are examined. The examples include work in both the time-resolved and time-averaged domains. K.S.

N92-22525*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CHEMICAL REACTING FLOWS **c34**
Edward J. Mularz (Army Aviation Systems Command, Cleveland, OH.) and Peter M. Sockol *In its* Aeropropulsion 1987 Feb. 1990 p 197-208 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

Future aerospace propulsion concepts involve the combustion of liquid or gaseous fuels in a highly turbulent internal airstream. Accurate predictive computer codes which can simulate the fluid mechanics, chemistry, and turbulence-combustion interaction of these chemical reacting flows will be a new tool that is needed in the design of these future propulsion concepts. Experimental and code development research is being performed at LeRC to better understand chemical reacting flows with the long-term goal of establishing these reliable computer codes. Our approach to understand chemical reacting flows is to look at separate, more simple parts of this complex phenomenon as well as to study the full turbulent reacting flow process. As a result, we are engaged in research on the fluid mechanics associated with chemical reacting flows. We are also studying the chemistry of fuel-air combustion. Finally, we are investigating the phenomenon of turbulence-combustion interaction. Research, both experimental and analytical, is highlighted in each of these three major areas. Author

N92-22526*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RESEARCH SENSORS **c35**
David R. Englund *In its* Aeropropulsion 1987 Feb. 1990 p 217-224 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 14B

The LeRC program in research sensors is directed at development of sensors and sensing techniques for research applications on turbine engines and propulsion systems. In general, the sensors are used either to measure to response of an engine component to the imposed environment. Locations of concern are generally within the gas path and, for the most part, are within the hot section of the engine. Since these sensors are used for research testing as opposed to operational use, a sensor lifetime of the order of 50 hr is considered sufficient. The following discussion presents a sample of this work, describing programs to develop a dynamic gas temperature measuring system, total heat flux sensors, a variety of thin-film sensors, and high-temperature strain measuring systems. Author

N92-22527*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTICAL MEASUREMENT SYSTEMS **c35**
Daniel J. Lesco *In its* Aeropropulsion 1987 Feb. 1990 p 225-232 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 14B

Some of the areas of research conducted at the LeRC on optical measurement techniques for propulsion systems research are described. Most of the optical techniques used to measure gas parameters depend on very inefficient light scattering principles and, therefore, require the high light intensities provided by lasers. Significant advances in laser technology, together with the availability of sensitive photodetection systems, provide much of the impetus for research in optical diagnostics techniques. The goal of the research is to enhance the capabilities of nonintrusive research instrumentation to meet the special needs of aeropropulsion research. Optical techniques are being used to validate analytical codes and to verify the performance of aeropropulsion components and systems. Author

N92-22528*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE ELECTRONICS **c33**
Lawrence G. Matus and Gary T. Seng *In its* Aeropropulsion 1987 Feb. 1990 p 233-241 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 09C

To meet the needs of the aerospace propulsion and space power communities, the high temperature electronics program at the Lewis Research Center is developing silicon carbide (SiC) as a high temperature semiconductor material. This program supports a major element of the Center's mission - to perform basic and developmental research aimed at improving aerospace propulsion systems. Research is focused on developing the crystal growth, characterization, and device fabrication technologies necessary to produce a family of SiC devices. Author

N92-22529*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIBER OPTICS FOR CONTROLS **c08**
Gary T. Seng *In its* Aeropropulsion 1987 Feb. 1990 p 243-249 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 01C

The design, development, and testing of a fiber optic integrated propulsion/flight control system for an advanced supersonic dash aircraft (flies at supersonic speeds for short periods of time) is the goal of the joint NASA/DOD Fiber Optic Control System Integration (FOCSI) program. Phase 1 provided a comparison of electronic and optical control systems, identified the status of current optical sensor technology, defined the aircraft sensor/actuator environment, proposed architectures for fully optical control systems, and provided schedules for development. Overall, it was determined that there are sufficient continued efforts to develop such a system. It was also determined that it is feasible to build a fiber optic control system for the development of a data base for this technology, but that further work is necessary in sensors, actuators, and components to develop an optimum design, fully fiber optic integrated control system compatible with advanced aircraft environments. Phase 2 is to design, construct, and ground test a fly by light control system. Its first task is to provide a detailed design of the electro-optic architecture. Author

N92-22530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DIRECTIONS IN PROPULSION CONTROL
Carl F. Lorenzo *In its* Aeropropulsion 1987 Feb. 1990 p 251-260 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Discussed here is research at NASA Lewis in the area of propulsion controls as driven by trends in advanced aircraft. The objective of the Lewis program is to develop the technology for advanced reliable propulsion control systems and to integrate the propulsion control with the flight control for optimal full-system control. Author

N92-22531*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OVERVIEW OF THE SUBSONIC PROPULSION TECHNOLOGY SESSION
G. Keith Sievers *In its* Aeropropulsion 1987 Feb. 1990 p 271-278 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

NASA is conducting aeronautical research over a broad range of Mach numbers. In addition to the generic and high speed propulsion research, the Lewis Research Center is continuing its substantial efforts towards propulsion technology for a broad range of subsonic flight applications. Reviewed here are some of the elements of that program, including small engine technology, rotorcraft, icing research, hot section technology, and the Advanced Turboprop Project. Author

N92-22532*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SMALL ENGINE TECHNOLOGY PROGRAMS
Richard W. Niedzwiecki *In its* Aeropropulsion 1987 Feb. 1990 p 279-302 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Described here is the small engine technology program being sponsored at the Lewis Research Center. Small gas turbine research is aimed at general aviation, commuter aircraft, rotorcraft, and cruise missile applications. The Rotary Engine program is aimed at supplying fuel flexible, fuel efficient technology to the general aviation industry, but also has applications to other missions. The Automotive Gas Turbine (AGT) and Heavy-Duty Diesel Transport Technology (HDTT) programs are sponsored by DOE. The Compound Cycle Engine program is sponsored by the Army. All of the programs are aimed towards highly efficient engine cycles, very efficient components, and the use of high temperature structural ceramics. This research tends to be generic in nature and has broad applications. The HDTT, rotary technology, and the compound cycle programs are all examining approaches to minimum heat rejection, or 'adiabatic' systems employing advanced materials. The AGT program is also directed towards ceramics application to gas turbine hot section components. Turbomachinery advances in the gas turbine programs will benefit advanced turbochargers and turbocompounders for the intermittent combustion systems, and the fundamental understandings and analytical codes developed in the research and technology programs will be directly applicable to the system projects. Author

N92-22533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ROTORCRAFT TRANSMISSIONS
John J. Coy *In its* Aeropropulsion 1987 Feb. 1990 p 303-313 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Highlighted here is that portion of the Lewis Research Center's helicopter propulsion systems program that deals with drive train technology and the related mechanical components. The major goals of the program are to increase life, reliability, and maintainability, to reduce weight, noise, and vibration, and to maintain the relatively high mechanical efficiency of the gear train. The current activity emphasizes noise reduction technology and analytical code development, followed by experimental verification. Selected significant advances in technology for transmissions are reviewed, including advanced configurations and new analytical tools. Finally, the plan for transmission research in the future is presented. Author

N92-22534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE NASA AIRCRAFT ICING RESEARCH PROGRAM **c05**
Robert J. Shaw and John J. Reinmann *In its* Aeropropulsion 1987 Feb. 1990 p 315-341 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 01C

The objective of the NASA aircraft icing research program is to develop and make available to industry icing technology to support the needs and requirements for all-weather aircraft designs. Research is being done for both fixed wing and rotary wing applications. The NASA program emphasizes technology development in two areas, advanced ice protection concepts and icing simulation. Reviewed here are the computer code development/validation, icing wind tunnel testing, and icing flight testing efforts. Author

N92-22535*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AIRCRAFT ENGINE HOT SECTION TECHNOLOGY: AN OVERVIEW OF THE HOST PROJECT
Daniel E. Sokolowski and Marvin H. Hirschberg *In its* Aeropropulsion 1987 Feb. 1990 p 343-361 (For primary

document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

NASA sponsored the Turbine Engine Hot Section (HOST) project to address the need for improved durability in advanced aircraft engine combustors and turbines. Analytical and experimental activities aimed at more accurate prediction of the aerothermal environment, the thermomechanical loads, the material behavior and structural responses to loads, and life predictions for cyclic high temperature operation were conducted from 1980 to 1987. The project involved representatives from six engineering disciplines who are spread across three work disciplines - industry, academia, and NASA. The HOST project not only initiated and sponsored 70 major activities, but also was the keystone in joining the multiple disciplines and work sectors to focus on critical research needs. A broad overview of the project is given along with initial indications of the project's impact. Author

N92-22536*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OVERVIEW OF NASA PTA PROPFAN FLIGHT TEST PROGRAM
Edwin J. Graber *In its* Aeropropulsion 1987 Feb. 1990 p 363-382 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

The progress is covered of the NASA sponsored Propfan Test Assessment (PTA) flight test program. In PTA, a 9 ft. diameter propfan was installed on the left wing of a Gulfstream GII executive jet and is undergoing extensive flight testing to evaluate propfan structural integrity, near and far field noise, and cabin interior noise characteristics. This research testing includes variations in propeller tip speed and power loading, nacelle tilt angle, and aircraft Mach number and altitude. As a result, extensive parametric data will be obtained to verify and improve computer codes for predicting propfan aeroelastic, aerodynamic, and aeroacoustic characteristics. Over 600 measurements are being recorded for each of approx. 600 flight test conditions. Author

N92-22537*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCED PROPELLER RESEARCH
John F. Groeneweg and Lawrence J. Bober *In its* Aeropropulsion 1987 Feb. 1990 p 383-406 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Recent results of aerodynamic and acoustic research on both single rotation and counterrotation propellers are reviewed. Data and analytical results are presented for three propellers: SR-7A, the single rotation design used in the NASA Propfan Test Assessment (PTA) flight program; CRP-X1, the initial 5+5 Hamilton Standard counterrotating design; and F7-A7, the 8+8 counterrotating G.E. design used in the proof of concept Unducted Fan (UDF) engine. In addition to propeller efficiencies, cruise and takeoff noise, and blade pressure data, off-design phenomena involving formation of leading edge vortexes are described. Aerodynamic and acoustic computational results derived from 3-D Euler and acoustic radiation codes are presented. Research on unsteady flows which are particularly important for understanding counterrotation interaction noise, unsteady loading effects on acoustics, and flutter or forced response is described. The first results of 3-D unsteady Euler solutions are illustrated for a single rotation propeller at angle of attack and for a counterrotation propeller. Basic experimental and theoretical results from studies on the unsteady aerodynamics of oscillating cascades are outlined. Author

N92-22538*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA THRUSTS IN HIGH-SPEED AEROPROPULSION RESEARCH AND DEVELOPMENT: AN OVERVIEW
Joseph A. Ziemianski *In its* Aeropropulsion 1987 Feb. 1990 p 407-411 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

NASA is conducting aeronautical research over a broad range of Mach numbers. In addition to the advanced conventional takeoff or landing (CTOL) propulsion research described elsewhere, NASA Lewis has intensified its efforts towards propulsion technology for selected high speed flight applications. In a companion program, NASA Langley has also accomplished significant research in supersonic combustion ramjet (SCRAM) propulsion. An unclassified review is presented of the propulsion research results that are applicable for supersonic to hypersonic vehicles. This overview not only provides a preview of the more detailed presentations which follow, it also presents a viewpoint on future research directions by calling attention to the unique cycles, components, and facilities involved in this expanding area of work. Author

N92-22539*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUPERSONIC STOVL PROPULSION TECHNOLOGY PROGRAM: AN OVERVIEW
Bernard J. Blaha and Peter G. Batterton *In its* Aeropropulsion 1987 Feb. 1990 p 413-436 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

Planning activities are continuing between NASA, the DoD, and two foreign governments to develop the technology and to show the design capability by the mid-1990's for advanced, supersonic, short takeoff and vertical landing (STOVL) aircraft. Propulsion technology is the key to achieving viable STOVL aircraft, and NASA Lewis will play a lead role in the development of these required propulsion technologies. The initial research programs are focused on technologies common to two or more of the possible STOVL propulsion system concepts. An overview is presented of the NASA Lewis role in the overall program plan and recent results of the research program. The future research program will be focused on one or possibly two of the propulsion concepts seen as most likely to be successful in the post advanced tactical fighter time frame. Author

N92-22540*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROPULSION CHALLENGES AND OPPORTUNITIES FOR HIGH-SPEED TRANSPORT AIRCRAFT
William C. Strack *In its* Aeropropulsion 1987 Feb. 1990 p 437-452 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

The major challenges confronting the propulsion community for supersonic transport applications are identified. Both past progress and future opportunities are discussed in relation to perceived technology shortfalls for an economically successful SST that satisfies environmental constraint. A very large improvement in propulsion system efficiency is needed both at supersonic cruise and subsonic cruise conditions. Toward this end, several advanced engine concepts are being considered that promise up to 25 pct. better efficiency than the Concorde engine. The quest for high productivity through higher speed is also thwarted by the lack of a conventional, low priced fuel that is thermally stable at the higher temperatures associated with faster flight. Extending Jet A type fuel to higher temperatures and the adoption of liquid natural gas or methane are two possibilities requiring further study. Airport noise remains a tough challenge because previously researched concepts fall short of achieving FAR 36 Stage III noise levels. Innovative solutions may be necessary to reach acceptably low noise. Author

N92-22541*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUPERSONIC THROUGHFLOW FANS FOR HIGH-SPEED AIRCRAFT
Calvin L. Ball and Royce D. Moore *In its* Aeropropulsion 1987 Feb. 1990 p 453-468 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

A brief overview is provided of past supersonic throughflow fan activities; technology needs are discussed; the design is described of a supersonic throughflow fan stage, a facility inlet,

and a downstream diffuser; and the results are presented from the analysis codes used in executing the design. Also presented is a unique engine concept intended to permit establishing supersonic throughflow within the fan on the runway and maintaining the supersonic throughflow condition within the fan throughout the flight envelope. Author

N92-22542*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-SPEED INLET RESEARCH PROGRAM AND SUPPORTING ANALYSIS c34
Robert E. Coltrin *In its* Aeropropulsion 1987 Feb. 1990 p 469-486 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

The technology challenges faced by the high speed inlet designer are discussed by describing the considerations that went into the design of the Mach 5 research inlet. It is shown that the emerging three dimensional viscous computational fluid dynamics (CFD) flow codes, together with small scale experiments, can be used to guide larger scale full inlet systems research. Then, in turn, the results of the large scale research, if properly instrumented, can be used to validate or at least to calibrate the CFD codes. Author

N92-22543*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HYPERSONIC PROPULSION RESEARCH
G. Burton Northam *In* NASA. Lewis Research Center, Aeropropulsion 1987 Feb. 1990 p 487-506 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 21E

The development of technology for the modular airframe integrated scramjet has been the focus of hypersonic propulsion research for several years. An part of this research, a variety of inlet concepts have been explored and characterized. The emphasis of the inlet program has been the development of the short (light weight), fixed geometry, side wall compression inlets that operate efficiently over a wide Mach number range. As hypersonic combustion tunnels were developed, programs to study the parameters controlling fuel mixing and combustion with single and multiple strut models were conducted using direct connect test techniques. These various tests supported the design of subscale engine test hardware that integrated inlet and combustor technology and allowed the study of the effect of heat release on thrust and combustor/inlet interaction. A number of subscale engine tests have shown predicted performance levels at Mach 4 and 7 simulated flight conditions. A few of the highlights from this research program are summarized. Author

N92-22647*# Iowa State Univ. of Science and Technology, Ames. Engine Research Inst.
A TWO-STROKE DIESEL ENGINE SIMULATION PROGRAM Final Report
Jon H. VanGerpen Feb. 1990 25 p Sponsored by NASA. Lewis Research Center
(Contract DAAL03-86-D-0001; DA Proj. 1L1-61102-AH-45)
(NASA-CR-185155; E-5121; NAS 1.26:185155; ERI-89179; AVSCOM-TR-88-C-024) Avail: NTIS HC/MF A03 CSCL 21E

A computer program simulating a two stroke diesel engine is developed and documented. The program is suitable for simulating the diesel core of a high output combined-cycle diesel engine. The engine cylinder and the intake and exhaust ports are defined as independent thermodynamic systems and the mass and energy equations for these systems are developed. A single zone combustion model is used and perfect mixing during scavenging is assumed. The program input requirements and output results are discussed. A sample case is provided for an opposed piston, uniflow scavenged two stroke diesel engine. Author

N92-22863*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DESIGN AND PERFORMANCE OF CONTROLLED-DIFFUSION STATOR COMPARED WITH ORIGINAL DOUBLE-CIRCULAR-ARC STATOR
Thomas F. Gelder, James F. Schmidt, Kenneth L. Suder, and Michael D. Hathaway (Army Aviation Systems Command, Cleveland, OH.) Mar. 1989 80 p Presented at the 1987 Aerospace Technology Conference and Exposition, Long Beach, CA, 5-8 Oct. 1987; sponsored by SAE
(DA Proj. 1L1-61102-AH-45)
(NASA-TP-2852; E-4195; NAS 1.60:2852; AVSCOM-TR-88-C-013; SAE-871783) Avail: NTIS HC/MF A05 CSCL 21E

The performance of a fan stator blade row having Controlled Diffusion (CD) blade sections were compared with the performance of a fan stator blade row having Double Circular Arc (DCA) blade sections. A CD stator with the same chord length but half the blades of the DCA stator was designed and tested. The same fan rotor (tip speed, 429 m/sec; pressure ratio, 1.64) was used with each stator row. The design and analysis system for the CD stator is described. The overall stage and rotor performance with each stator are then compared along with selected stator blade element data. The CD stator efficiency drop (rotor minus stage efficiency overall) was about one percentage point higher than for the DCA stator at or near design speed of high losses in the hub region. Author

N92-22276# National Aerospace Lab., Amsterdam (Netherlands). Propulsion Aerodynamics and Acoustics Dept.
RAMJET TECHNOLOGY DEMONSTRATION PROGRAM
W. B. deWolf *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 171-182 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

N92-22492*# Akron Univ., OH.
A HIERARCHY FOR MODELING HIGH SPEED PROPULSION SYSTEMS
Tom T. Hartley and Alex DeAbreu *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 p 1-20 Previously announced as N92-19934 (For primary document see N92-22491 13-34)
(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 21E

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N92-22157 Stanford Univ., CA.
HELICOPTER ACTIVE ROTOR CONTROL Ph.D. Thesis
James Willard Fuller 1991 314 p
Avail: Univ. Microfilms Order No. DA9206767

A methodology for designing helicopter active rotor control algorithms was developed. A rotor can be regarded as an actuator whose outputs are the three components of thrust and whose inputs are collective, longitudinal cyclic, and lateral cyclic blade pitch. Active control can make the output response faster and more precise, eliminate cross-coupling, attenuate unwanted responses to gusts, and suppress vibration. The active control concept investigated here consists of sensors that measure the angles of rotation of the rotor flapping hinges of a fully articulated rotor, a computer that implements the control logic, and

servo-actuators that move the swashplate to control blade pitch. The methodology for designing the control logic is described.
Dissert. Abstr.

N92-22194*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
VARIABLE-CAMBER SYSTEMS INTEGRATION AND OPERATIONAL PERFORMANCE OF THE AFTI/F-111 MISSION ADAPTIVE WING
John W. Smith (PRC Systems Services Co., Edwards, CA.), Wilton P. Lock, and Gordon A. Payne Apr. 1992 43 p
(NASA-TM-4370; H-1748; NAS 1.15:4370) Avail: NTIS HC/MF A03 CSCL 01C

The advanced fighter technology integration, the AFTI/F-111 aircraft, is a preproduction F-111A testbed research airplane that was fitted with a smooth variable-camber mission adaptive wing. The camber was positioned and controlled by flexing the upper skins through rotary actuators and linkages driven by power drive units. The wing camber and control system are described. The measured servoactuator frequency responses are presented along with analytical predictions derived from the integrated characteristics of the control elements. A mission adaptive wing system chronology is used to illustrate and assess the reliability and dependability of the servoactuator system during 1524 hours of ground tests and 145 hours of flight testing. Author

N92-22529*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIBER OPTICS FOR CONTROLS
Gary T. Seng *In its* Aeropropulsion 1987 Feb. 1990 p 243-249 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 01C

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-22096# Rolls-Royce Ltd., Bristol (England). Military Demonstrators.
RECENT DEVELOPMENTS AT THE SHOEBURYNESS (ENGLAND) STOVL TEST FACILITY
L. H. K. Reed 1 Sep. 1990 10 p
(PNR-90806; ETN-92-90776) Copyright Avail: NTIS HC/MF A02

The last two years have seen a number of test programs performed that are directly targeted at the technology acquisition need for the next generation of STOVL (Short Take Off Vertical Landing) fighter aircraft. The facilities used comprise a dynamic test gantry with airframe and two augmented powerplants allowing operation in ground effect to be simulated at full scale over a wide range of jet energies and configurations. The areas of concern in the ground environment of a STOVL vehicle are described, together with how the current test programs are acquiring the knowledge to give confidence that the design solution will be satisfactory in service operation. ESA

N92-22195*# MCAT Inst., San Jose, CA.
STUDY OF OPTICAL TECHNIQUES FOR THE AMES UNITARY WIND TUNNELS. PART 2: LIGHT SHEET AND VAPOR SCREEN Progress Report
George Lee Mar. 1992 34 p
(Contract NCC2-716)
(NASA-CR-190217; NAS 1.26:190217; MCAT-92-004) Avail: NTIS HC/MF A03 CSCL 14B

Light sheet and vapor screen methods have been studied with particular emphasis on those systems that have been used in large transonic and supersonic wind tunnels. The various fluids and solids used as tracers or light scatters and the methods for tracing generation have been studied. Light sources from high intensity lamps and various lasers have been surveyed. Light sheet generation and projection methods were considered. Detectors and location of detectors were briefly studied. A vapor screen system and a technique for location injection of tracers for the NASA Ames 9 by 7 foot Supersonic Wind Tunnel were proposed.
Author

N92-22237# Federal Aviation Administration, Atlantic City, NJ.
COMPARATIVE EVALUATION OF INTERNALLY AND EXTERNALLY LIGHTED TAXIWAY GUIDANCE SIGNS
Eric S. Katz Jan. 1992 10 p Original contains color illustrations
(DOT/FAA/CT-TN92/2) Avail: NTIS HC/MF A02

A comparative evaluation of two types of illuminated airport signs was conducted at the Federal Aviation Administration (FAA) Technical Center. The purpose of the evaluation was to determine if one sign illumination technique exhibited significantly better performance than the other technique. To obtain performance data applicable to signs presently in service, samples of both internally and externally illuminated signs were obtained and evaluated. Results of the evaluation indicate that the performance of the internally illuminated taxiway guidance signs can be expected to be significantly better than that of externally lighted signs, especially at greater viewing distances and under conditions of reduced visibility. Author

N92-22503# Federal Aviation Administration, Atlantic City, NJ.
MLS MATHEMATICAL MODELING STUDY OF PHILADELPHIA INTERNATIONAL AIRPORT RUNWAY 27L Technical Report, Mar. - Nov. 1991
Linda Pasquale Mar. 1992 23 p
(Contract FAA-T0603-B)
(DOT/FAA/CT-TN91/54; ACD-330) Avail: NTIS HC/MF A03

A mathematical modeling study of the proposed Microwave Landing System (MLS) for runway 27L at Philadelphia International Airport was performed at the request of the MLS Program Office. The study focused on the feasibility of three offset approaches designed to maintain acceptable separation distance from aircraft approaching runway 27R. Modeling was performed using these three approaches, two elevation sites, one azimuth site, and several potential multipath obstacles. Results of the modeling study indicate that the three offset approach procedures would be feasible in this environment. No problematic effects from the airport environment were predicted within the usable coverage volume of the MLS signal. Author

N92-22966# Federal Aviation Administration, Atlantic City, NJ.
AIRPORT SMART POWER LIGHTING SYSTEM
Larry N. VanHoy Feb. 1992 13 p
(DOT/FAA/CT-TN91/12) Avail: NTIS HC/MF A03

The Swedish Airport Smart Power (ASP) System has been installed at the Federal Aviation Administration Technical Center, Atlantic City International Airport, (ACY) NJ. The purpose of this system is to provide control of individual lights on an airport from a remote location such as the Air Traffic Control Tower. A demonstration of the installed system's capabilities was conducted. Control of individual airport lights enhance the operation of systems such as hold-short bars, stopbars, wig-wag lights, taxiway guidance, lead-in lights, clearance bars, and control of lighted signs.
Author

N92-22437*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
APPLICATION OF TECHNOLOGY DEVELOPED FOR FLIGHT SIMULATION AT NASA. LANGLEY RESEARCH CENTER
Jeff I. Cleveland, II *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 109-117 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N92-22489*# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.
NASA/USRA ADVANCED DESIGN PROGRAM, 1990 - 1991
10 Jul. 1991 36 p
(Contract NASw-4435)
(NASA-CR-190021; NAS 1.26:190021) Avail: NTIS HC/MF A03 CSCL 22A

Twenty-four UCLA students, in groups of four or five, participated in a mission design for a manned expedition to Mars that was based on the concept of mid-course refueling from electrically propelled tankers launched ahead of the manned mission. The study was conducted during the 1991 spring term. Some of the student groups opted for non-nuclear propulsion of the manned ship, based on LOX and LH2; others opted for one based on nuclear thermal propulsion. By way of example, the first option is presented here. Author

N92-22502*# Boeing Co., Huntsville, AL. Advanced Civil Space Systems.
SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS Final Report
Dec. 1991 237 p
(Contract NAS8-37857)
(NASA-CR-184301; NAS 1.26:184301; D615-10045-2) Avail: NTIS HC/MF A11 CSCL 22A

Covered here is the second phase of a broad scoped and systematic study of space transfer concepts for human lunar and Mars missions. The study addressed issues that were raised during Phase 1, developed generic Mars missions profile analysis data, and conducted preliminary analysis of the Mars in-space transportation requirements and implementation from the Stafford Committee Synthesis Report. Author

N92-22359*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXPERIMENTS TO BE FLOWN IN AN EARTH ORBITING LABORATORY: THE US EXPERIMENTS ON THE FIRST INTERNATIONAL MICROGRAVITY LABORATORY, FROM CONCEPT TO FLIGHT
C. M. Winget, P. X. Callahan, R. L. Schaefer (Lockheed Engineering and Sciences Co., Moffett Field, CA.), and J. J. Lashbrook *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 642-647 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22A

N92-22375*# Orion International Technologies, Albuquerque, NM.
THE ASSESSMENT OF LONG-TERM ORBITAL DEBRIS MODELS
F. M. Jonas and K. W. Yates *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 734-741 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22A

N92-22376*# Phillips Lab., Kirkland AFB, NM. Space Kinetic Impact and Debris Branch.
SPACE DEBRIS CHARACTERIZATION IN SUPPORT OF A SATELLITE BREAKUP MODEL
Bryan H. Fortson, James E. Winter, and Firooz A. Allahdadi *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 742-749 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22A

N92-22378*# Phillips Lab., Hanscom AFB, MA. Geophysics Directorate.
SPACE DEBRIS MEASUREMENT PROGRAM AT PHILLIPS LABORATORY
Phan D. Dao and Ross T. McNutt *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 756 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22A

N92-22379*# Naval Research Lab., Washington, DC. Space Plasma Branch.
DEBRIS AND MICROMETEORITE IMPACT MEASUREMENTS IN THE LABORATORY
J. Resnick, J. Grun, J. Crawford, R. Burris (Physical Sciences, Inc., Alexandria, VA.), C. K. Manka, J. L. Ford, and B. H. Ripin *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 758-762 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22A

N92-23065# Technische Univ., Delft (Netherlands). Faculties of Geodesy/Aerospace Engineering.
EARTH ORIENTED SPACE RESEARCH AT DELFT UNIVERSITY OF TECHNOLOGY Progress Report
E. Vermaat and K. F. Wakker *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 104-111 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-22622# National Aerospace Lab., Tokyo (Japan). Control Systems Div.
GPS SATELLITE ORBIT DETERMINATION USING PSEUDORANGE DATA: EXPERIMENTS AND RESULTS
Masaaki Murata, Tomiyoshi Yamamoto, and Yasuhiro Hamada (Daiko Ltd., Japan) May 1991 19 p
(NAL-TR-1110T; ISSN-0389-4010) Avail: NTIS HC/MF A03

A Global Positioning System (GPS) orbit determination software system called the Multi-Satellite Orbit Processor (MSOP) has been developed, and uses pseudo range data to determine accurate orbits for the GPS satellite constellation. Methods and strategies specific to the precise orbit determination of GPS satellites are described, with special emphasis placed on force modeling of the solar radiation pressure and y-bias. The orbit accuracy was evaluated from analysis of P-code pseudorange data collected by the Cooperative International GPS Network (CIGNET), being primarily based on a direct comparison with the precise ephemerides generated at the Naval Surface Warfare Center (NSWC). Methods leading to an orbit accuracy of better than 0.5 ppm were demonstrated. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N92-22272# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.
EXPERIMENTAL FACILITIES FOR SOLID FUEL COMBUSTION CHAMBER RESEARCH

F. Dijkstra and T. Wijchers *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 73-101 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

N92-22598*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
AGREEMENTS/SUBAGREEMENTS APPLICABLE TO WALLOPS, 12 NOV. 1991
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 22 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

N92-22599*# Army Missile Test and Evaluation Directorate, White Sands Missile Range, NM.
ABOUT WHITE SANDS MISSILE RANGE
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 16 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

N92-22600*# Spaceport Florida Authority, Cape San Blas.
SPACEPORT FLORIDA AUTHORITY
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 15 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

N92-22601*# Bristol Aerospace Ltd., Winnipeg (Manitoba).
BRISTOL TODAY
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 26 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

N92-22602*# Orbital Sciences Corp., Fairfax, VA. Space Data Div.
INTRODUCTION TO ORBITAL SCIENCES CORPORATION
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 13 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N92-22595*# National Aeronautics and Space Administration, Washington, DC.
WORKSHOP ON THE SUBORBITAL SCIENCE SOUNDING ROCKET PROGRAM, VOLUME 1
1991 182 p Workshop held in Washington, DC, 12-13 Nov. 1991
(NASA-TM-105448; NAS 1.15:105448) Avail: NTIS HC/MF A09 CSCL 22B

The unique characteristics of the sounding rocket program is described, with its importance to space science stressed, especially in providing UARS correlative measurements. The program provided opportunities to do innovative scientific studies in regions not other wise accessible; it was a testbed for developing new technologies; and its key attributes were flexibility, reliability, and economy. The proceedings of the workshop are presented in viewgraph form, including the objectives of the workshop and the workshop agenda. For individual titles, see N92-22596 through N92-22603.

N92-22596*# National Aeronautics and Space Administration, Washington, DC.
SCIENCE COMMUNITY INTERFACE
Werner M. Neupert *In its* Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 8 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 22B

The interface is described between NASA HQ, NASA Goddard, and the rocket Principal Investigators. The proposal selection process is described along with the cycle time to flight, constraints imposed by science objectives on operations, campaign modes, and coordination with ground based facilities. There were questions about the success rate of proposals and the primary sources of funding for the payloads program from the branches of the science divisions in OSSA, especially space physics, astrophysics, Earth sciences, and solar system exploration. The presentation is given in the form of viewgraphs. Author

N92-22597*# Boston Univ., MA. Dept. of Astronomy.
INVESTIGATOR PERSPECTIVES
Michael Mendillo *In* NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 36 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 22B

A detailed presentation is given in the form of viewgraphs on principal investigator requirements ranging from simple to complex payloads. It is stated that the program was very important to the US science community, and that there was already concern that its funding was under stress, impacting the number of missions flown, down from around 44 to 25 or so. It is also stated that the program needs more help at NASA HQ. E.R.

N92-22598*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
AGREEMENTS/SUBAGREEMENTS APPLICABLE TO WALLOPS, 12 NOV. 1991 **c14**
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 22 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

The status of space science agreements are noted. A general overview of the Wallops Flight Facility (WFF) is given. The geography, history, and mission of the facility are briefly surveyed. Brief accounts are given of NASA earth science activities at the WFF, including atmospheric dynamics, atmospheric optics, ocean physics, microwave altimetry, ocean color research, wind-wave-current interaction, flight support activities, the Sounding Rocket Program, and the NASA Balloon Program. Also discussed are the WFF launch range, the research airport, aircraft airborne science, telemetry, data systems, communications, and command and control. Author

N92-22599*# Army Missile Test and Evaluation Directorate, White Sands Missile Range, NM.
ABOUT WHITE SANDS MISSILE RANGE **c14**
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 16 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

Information on the White Sands Missile Range is given in viewgraph form. Navy programs, test sites, rocket programs, research rockets' booster capacity, current boost capabilities, ordnance and payload assembly areas, commercial space launch history and agreements, and lead times are among the topics covered. Author

N92-22600*# Spaceport Florida Authority, Cape San Blas.
SPACEPORT FLORIDA AUTHORITY **c14**
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 15 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

The topics are covered in viewgraph form and include the

following: objectives; current initiatives; the Space Research Initiative Program; the Cape San Blas Launch Program; and Spaceport Florida Laboratories. K.S.

N92-22601*# Bristol Aerospace Ltd., Winnipeg (Manitoba).
BRISTOL TODAY c14
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 26 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

The topics are presented in viewgraph form and include the following: corporate organization; product groups; the CRV7 rocket weapon system; Black Brant Sounding Rockets; apogee performance; space payload experience; the Orbital Express; and program and procurement requirements. K.S.

N92-22602*# Orbital Sciences Corp., Fairfax, VA. Space Data Div.
INTRODUCTION TO ORBITAL SCIENCES CORPORATION c14
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 13 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 14B

A general overview of the Orbital Sciences Corporation (OSC) is presented. The following topics are covered: (1) manpower, facilities, and financial growth; (2) organization and management team; (3) the Space Data Division organization; (4) the Chandler facility; (5) Space Data-Products and Services; (6) space transportation systems; (7) spacecraft and space support systems; (8) turn-key suborbital launch services and support systems; and (9) OSC suborbital booster performance. D.R.D.

N92-22603*# American Rocket Co., Camarillo, CA. HyFlyer Sounding Rocket Program.
HYBRID ROCKET PROPULSION FOR SOUNDING ROCKET APPLICATIONS
In NASA, Washington, Workshop on the Suborbital Science Sounding Rocket Program, Volume 1 1991 9 p (For primary document see N92-22595 13-15)
Avail: NTIS HC/MF A09 CSCL 22B

A discussion of the H-225K hybrid rocket motor, produced by the American Rocket Company, is given. The H-225K motor is presented in terms of the following topics: (1) hybrid rocket fundamentals; (2) hybrid characteristics; and (3) hybrid advantages. D.R.D.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

N92-22164 Michigan Univ., Ann Arbor.
AUTOMATIC SPACECRAFT DOCKING USING COMPUTER VISION AND NONLINEAR CONTROL TECHNIQUES Ph.D. Thesis
Chi-Chang Johnny Ho 1991 172 p
Avail: Univ. Microfilms Order No. DA9135608

An innovative approach to automatic spacecraft docking using computer vision and nonlinear control techniques is presented. Docking is one of the most important spacecraft functions. Docking between a spacecraft and a space station is called 'soft' if the final approach speed along the range direction is slow. Precise control of the relative spacecraft velocity is required to achieve soft docking. To achieve automatic spacecraft docking, we propose use of a computer vision system as a position and orientation measurement device for obtaining feedback information used by velocity observers and control laws. A camera, fixed to the spacecraft, is assumed to track a standard rhombus mark fixed on the space station. Using this computer vision system as a sensor, the spacecraft (camera) position and orientation relative to the space station are estimated. The accuracy of the estimates improves as the relative range decreases and does not diverge with mission duration. Therefore, a computer vision based docking system is especially suited for slow, precise spacecraft docking missions. A guidance plan which satisfies the spacecraft soft docking requirement provides the desired input commands to the spacecraft control loops. We propose a guidance plan based on an 'N percent Rule' according to current NASA space shuttle docking mission design. Nonlinear rotational velocity estimation and attitude control loops are designed to track the desired rotational guidance commands to keep the camera, fixed on the spacecraft, always pointed at the rhombus mark on the space station. Linear translational velocity estimation and control loops are designed to track the desired translational guidance commands to perform precise control of the spacecraft velocity along the range direction to achieve soft docking. The individual computer vision and guidance, estimation and control loops are integrated into a complete docking system, which is formulated in detail. Computer simulation of an integrated docking system has been performed and demonstrates achievement of the soft docking requirement. These results verify the practical feasibility of this proposed automatic spacecraft docking system. Dissert. Abstr.

N92-22660*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SPACE TRANSPORTATION MATERIALS AND STRUCTURES TECHNOLOGY WORKSHOP. VOLUME 1: EXECUTIVE SUMMARY
F. W. Cazier, Jr., comp. and J. E. Gardner, comp. Apr. 1992 34 p Workshop held in Newport News, VA, 23-26 Sep. 1991 (NASA-CP-3148-Vol-1; L-17098; NAS 1.55:3148-Vol-1) Avail: NTIS HC/MF A03 CSCL 22B

The workshop was held to provide a forum for communication within the space materials and structures technology developer and user communities. Workshop participants were organized into a Vehicle Technology Requirements session and three working panels: Materials and Structures Technologies for Vehicle Systems; Propulsion Systems; and Entry Systems. The goals accomplished were (1) to develop important strategic planning information necessary to transition materials and structures technologies from lab research programs into robust and affordable operational systems; (2) to provide a forum for the exchange of information and ideas between technology developers and users; and (3) to provide senior NASA management with a review of current space transportation programs, related subjects, and specific technology needs. The workshop thus provided a foundation on which a NASA and industry effort to address space transportation materials and structures technologies can grow. Author

N92-22383*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MEDIUM RESOLUTION SPECTRA OF THE SHUTTLE GLOW IN THE VISIBLE REGION OF THE SPECTRUM Abstract Only
R. A. Viereck, E. Murad, C. P. Pike, S. B. Mende, G. R. Swenson (Lockheed Missiles and Space Co., Palo Alto, CA.), F. L. Culbertson, and B. C. Springer *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 78 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N92-22319*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPERATING AND SERVICE MANUAL FOR THE NASA LEWIS AUTOMATED FAR-FIELD ANTENNA RANGE
John D. Terry Jan. 1992 28 p
(NASA-TM-105343; E-6712; NAS 1.15:105343) Avail: NTIS HC/MF A03 CSCL 20N

This NASA Lewis far-field antenna range was recently upgraded and automated to meet the growing and demanding needs of the satellite communications program. Here, assistance is offered in the operation and service of this range. The procedures for configuring the test hardware and for operating the Far-Field Antenna Measurement Program (FAMP) are given. Included are the steps for getting started and for installing the proper microwave equipment. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-22208*# Research Inst. for Computing and Information Systems, Houston, TX.
ROBUST CONTROL OF FLEXIBLE SPACE VEHICLES WITH MINIMUM STRUCTURAL EXCITATION: ON-OFF PULSE CONTROL OF FLEXIBLE SPACE VEHICLES Final Report
Bong Wie and Qiang Liu (Arizona State Univ., Tempe.) 21 Feb. 1992 89 p
(Contract NCC9-16; RICIS Proj. MS-05)
(NASA-CR-190172; NAS 1.26:190172) Avail: NTIS HC/MF A05 CSCL 22B

Both feedback and feedforward control approaches for uncertain dynamical systems (in particular, with uncertainty in structural mode frequency) are investigated. The control objective is to achieve a fast settling time (high performance) and robustness (insensitivity) to plant uncertainty. Preshaping of an ideal, time optimal control input using a tapped-delay filter is shown to provide a fast settling time with robust performance. A robust, non-minimum-phase feedback controller is synthesized with particular emphasis on its proper implementation for a non-zero set-point control problem. It is shown that a properly designed, feedback controller performs well, as compared with a time optimal open loop controller with special preshaping for performance robustness. Also included are two separate papers by the same authors on this subject. Author

N92-22214*# L'Garde, Inc., Tustin, CA.
INFLATED CONCEPTS FOR THE EARTH SCIENCE GEOSTATIONARY PLATFORM AND AN ASSOCIATED FLIGHT EXPERIMENT Final Report
G. Friese Jan. 1992 74 p
(Contract NAS1-18681)
(NASA-CR-187580; NAS 1.26:187580; LTR-90-GF-010) Avail: NTIS HC/MF A04 CSCL 22B

Large parabolic reflectors and solar concentrators are of great interest for microwave transmission, solar powered rockets, and Earth observations. Collector subsystems have been under slow development for a decade. Inflated paraboloids have a great weight and package volume advantage over mechanically erected systems and, therefore, have been receiving greater attention recently. The objective of this program was to produce a 'conceptual definition of an experiment to assess in-space structural damping characteristics and effects of the space meteoroid environment upon structural integrity and service life of large inflatable structures.' The flight experiment was to have been based upon an inflated solar concentration, but much of that was being done on other programs. To avoid redundancy, the Earth Science Geostationary Platform (ESGP) was selected as a focus mission for the experiment. Three major areas were studied: the ESGP reflector configuration; flight experiment; and meteoroids. Author

N92-22289*# Bowie State Univ., MD.
GUIDELINES AND RULES FOR AUTOMATED ASSEMBLY BY ROBOTS IN SPACE Final Report
Sadanand Srivastava [1992] 90 p
(Grant NAG5-1054)
(NASA-CR-190160; NAS 1.26:190160) Avail: NTIS HC/MF A05 CSCL 22B

The development of an expert system for a 'Mechanical Design System' is discussed. Two different implementation approaches are described. One is coded in C, and the other is realized by a software package - 'Exsys.' The first method has the advantage of greater flexibility and quicker responses, while the latter one is easier to develop. This report discusses the feasible ways to establish a real mechanical intelligent design system applying artificial intelligence techniques so that the products designed by this system could best meet the requirements for space assembly. Author

N92-22317* National Aeronautics and Space Administration, Washington, DC.
LARGE SPACE STRUCTURES AND SYSTEMS IN THE SPACE STATION ERA: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 03)
Dec. 1991 324 p
(NASA-SP-7085(03); NAS 1.21:7085(03)) Avail: NTIS HC A14 CSCL 22B

Bibliographies and abstracts are listed for 1221 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1, 1991 and June 30, 1991. Topics covered include large space structures and systems, space stations, extravehicular activity, thermal environments and control, tethering, spacecraft power supplies, structural concepts and control systems, electronics, advanced materials, propulsion, policies and international cooperation, vibration and dynamic controls, robotics and remote operations, data and communication systems, electric power generation, space commercialization, orbital transfer, and human factors engineering. Author

N92-22500*# Texas Univ., Austin. Dept. of Mechanical Engineering.
DESIGN OF AN UNMANNED, REUSABLE VEHICLE TO DE-ORBIT DEBRIS IN EARTH ORBIT
Shahed Aziz, Timothy W. Cunningham, and Michelle Moore-McCassey 1990 107 p Original contains color illustrations
(Contract NASw-4435)
(NASA-CR-189997; NAS 1.26:189997) Avail: NTIS HC/MF A06; 2 functional color pages CSCL 22B

The space debris problem is becoming more important because as orbital missions increase, the amount of debris increases. It was the design team's objective to present alternative designs and a problem solution for a deorbiting vehicle that will alleviate the problem by reducing the amount of large debris in earth orbit. The design team was asked to design a reusable, unmanned vehicle to de-orbit debris in earth orbit. The design team will also construct a model to demonstrate the system configuration and key operating features. The alternative designs for the unmanned, reusable vehicle were developed in three stages: selection of project requirements and success criteria, formulation of a

specification list, and the creation of alternatives that would satisfy the standards set forth by the design team and their sponsor. The design team selected a Chain and Bar Shot method for deorbiting debris in earth orbit. The De-orbiting Vehicle (DOV) uses the NASA Orbital Maneuvering Vehicle (OMV) as the propulsion and command modules with the deorbiting module attached to the front. Author

N92-22625*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
TWO STAGE TO ORBIT DESIGN
Jun. 1991 92 p
(Contract NASw-4435)
(NASA-CR-189994; NAS 1.26:189994) Avail: NTIS HC/MF A05 CSCL 22B

A preliminary design of a two-stage to orbit vehicle was conducted with the requirements to carry a 10,000 pound payload into a 300 mile low-earth orbit using an airbreathing first stage, and to take off and land unassisted on a 15,000 foot runway. The goal of the design analysis was to produce the most efficient vehicle in size and weight which could accomplish the mission requirements. Initial parametric analysis indicated that the weight of the orbiter and the transonic performance of the system were the two parameters that had the largest impact on the design. The resulting system uses a turbofan ramjet powered first stage to propel a scramjet and rocket powered orbiter to the stage point of Mach 6 to 6.5 at an altitude of 90,000 ft. Author

N92-23114*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRUCTURAL ANALYSIS OF THREE SPACE CRANE ARTICULATED-TRUSS JOINT CONCEPTS
K. Chauncey Wu and Thomas R. Sutter May 1992 32 p
(NASA-TM-4373; L-17047; NAS 1.15:4373) Avail: NTIS HC/MF A03 CSCL 22B

Three space crane articulated truss joint concepts are studied to evaluate their static structural performance over a range of geometric design parameters. Emphasis is placed on maintaining the four longeron reference truss performance across the joint while allowing large angle articulation. A maximum positive articulation angle and the actuator length ratio required to reach the angle are computed for each concept as the design parameters are varied. Configurations with a maximum articulation angle less than 120 degrees or actuators requiring a length ratio over two are not considered. Tip rotation and lateral deflection of a truss beam with an articulated truss joint at the midspan are used to select a point design for each concept. Deflections for one point design are up to 40 percent higher than for the other two designs. Dynamic performance of the three point design is computed as a function of joint articulation angle. The two lowest frequencies of each point design are relatively insensitive to large variations in joint articulation angle. One point design has a higher maximum tip velocity for the emergency stop than the other designs. Author

N92-22361*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASCAP/LEO SIMULATIONS OF SHUTTLE ORBITER CHARGING DURING THE SAMPIE EXPERIMENT
Ricaurte Chock *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 655-661 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

N92-22364*# Systems Science and Software, La Jolla, CA.
SPACECRAFT-PLASMA INTERACTION CODES: NASCAP/GEO, NASCAP/LEO, POLAR, DYNAPAC, AND EPSAT
M. J. Mandell, G. A. Jongeward, and D. L. Cooke (Phillips Lab., Hanscom AFB, MA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 672-679 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

N92-22366*# Phillips Lab., Hanscom AFB, MA.
VALIDATION AND APPLICATIONS OF THE POLAR CODE Abstract Only
David L. Cooke, Ira Katz, Gary Jongeward, John R. Lilley, Jr., and Maurice Tautz (RADEX, Inc., Bedford, MA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 690 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

N92-22367*# TRW Defense and Space Systems Group, Redondo Beach, CA.
APPLICATION OF ENGINEERING CODES TO THE ASSESSMENT OF SPACECRAFT CHARGING INDUCED HAZARDS Abstract Only
N. J. Stevens and M. R. Jones *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 691 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

N92-22861# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
ANNEX A: REQUIREMENTS FOR POLAR ORBIT
J. Morgan *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 274-279 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N92-22611*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WORKSHOP PROCEEDINGS: SENSOR SYSTEMS FOR SPACE ASTROPHYSICS IN THE 21ST CENTURY Executive Summary
In its Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 1-3 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

N92-22614*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSOR TECHNOLOGY WORKSHOP: STRUCTURE AND GOALS
Barbara A. Wilson *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 15-16 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

N92-22616*# Stanford Univ., CA.
REPORT OF THE ULTRAVIOLET AND VISIBLE SENSORS PANEL
J. Gethyn Timothy, M. Blouke, R. Bredthauer, R. Kimble, T.-H. Lee, M. Lesser, O. Siegmund, and G. Weckler (Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.) *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 27-33 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

N92-22617*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
REPORT OF THE DIRECT INFRARED SENSORS PANEL
Craig McCreight, R. Bharat, R. Capps, W. Forrest, A. Hoffman, R. McMurray, H. Moseley, M. Reine, P. Richards, and D. Smith (Los Alamos National Lab., NM.) et al *In* JPL, California Inst. of

Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 34-49 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

N92-22618*# Bell Telephone Labs., Inc., Holmdel, NJ.
REPORT OF THE HETERODYNE SUBMILLIMETER-WAVE SENSORS PANEL
Robert Wilson, G. Chin, T. Crowe, M. Feldman, M. Frerking, E. Kolberg, H. LeDuc, T. Phillips, F. Ulaby, and W. Wilson (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) et al *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 50-57 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

N92-22619*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPORT OF THE SENSOR READOUT ELECTRONICS PANEL
Eric R. Fossum, J. Carson, W. Kleinhans, W. Kosonocky, L. Kozlowski, A. Pecsalski, A. Silver, H. Spieler, and J. Woolaway (Amber Engineering Co., Goleta, CA.) *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 58-67 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

N92-22620*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPORT OF THE SENSOR COOLER TECHNOLOGY PANEL
Ronald Ross, S. Castles, N. Gautier, P. Kittel, and J. Ludwigsen (Strategic Defense Initiative Organization, Washington, DC.) *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 68-80 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-22167# Horizon Data Corp., Reston, VA. Power Information Center.
INTERAGENCY ADVANCED POWER GROUP MEETING MINUTES
1991 389 p Presented at the Interagency Advanced Power Group (IAPG) Joint Electrical/Systems/Solar Working Groups Meeting, Ft. Monmouth, NJ, 12-13 Nov. 1991
(Contract DE-AC01-90CE-90053)
(DE92-005499; CONF-9111143-Summ) Avail: NTIS HC/MF A17

This document contains the minutes and viewgraphs from a meeting of military personnel on the subject of power generation and distribution systems for military applications. Topics include heating and cooling systems for standard shelters, SDIO power programs, solar dynamic space power systems, hybrid solar dynamic/photovoltaic systems, pulsed power technology, high-T(c) superconductors, actuators, and other electronic equipment for aerospace vehicles. Attendees represented the U.S. Air Force, Army, Navy, and NASA. DOE

N92-22211*# Calspan-Buffalo Univ. Research Center, NY.
DEVELOPMENT OF AN INTEGRATED BEM APPROACH FOR HOT FLUID STRUCTURE INTERACTION: BEST-FSI: BOUNDARY ELEMENT SOLUTION TECHNIQUE FOR FLUID STRUCTURE INTERACTION Final Technical Report
G. F. Dargush, P. K. Banerjee, and Y. Shi (State Univ. of New York at Buffalo, Amherst.) Mar. 1992 386 p
(Grant NAG3-712)
(NASA-CR-190190; NAS 1.26:190190) Avail: NTIS HC/MF A17 CSCL 21H

As part of the continuing effort at NASA LeRC to improve both the durability and reliability of hot section Earth-to-orbit engine components, significant enhancements must be made in existing finite element and finite difference methods, and advanced techniques, such as the boundary element method (BEM), must be explored. The BEM was chosen as the basic analysis tool because the critical variables (temperature, flux, displacement, and traction) can be very precisely determined with a boundary-based discretization scheme. Additionally, model preparation is considerably simplified compared to the more familiar domain-based methods. Furthermore, the hyperbolic character of high speed flow is captured through the use of an analytical fundamental solution, eliminating the dependence of the solution on the discretization pattern. The price that must be paid in order to realize these advantages is that any BEM formulation requires a considerable amount of analytical work, which is typically absent in the other numerical methods. All of the research accomplishments of a multi-year program aimed toward the development of a boundary element formulation for the study of hot fluid-structure interaction in Earth-to-orbit engine hot section components are detailed. Most of the effort was directed toward the examination of fluid flow, since BEM's for fluids are at a much less developed state. However, significant strides were made, not only in the analysis of thermoviscous fluids, but also in the solution of the fluid-structure interaction problem. K.S.

N92-22268# Technische Univ., Delft (Netherlands).
SYMPOSIUM ON HIGH SPEED AIRBREATHING PROPULSION: THE SOLID FUEL COMBUSTION CHAMBER AND BEYOND
P.A.O.G. Korting (Prins Maurits Lab. TNO, Rijswijk, Netherlands) and H. Wittenberg 1991 196 p Symposium held in Delft, Netherlands, 7 Jun. 1991 Sponsored in cooperation with Netherlands Technology Foundation, TNO Defence Research, Project Management Office for Research, and National Fund for the Use of Supercomputers Original contains color illustrations
(ETN-92-90685) Avail: NTIS HC/MF A09

The main topics of a cooperative research program on solid fuel combustion with emphasis on airbreathing aerospace propulsion are summarized. The intention is to expose the theoretical and experimental capabilities obtained during the research program. An introduction to the Solid Fuel Combustion Chamber Project (SFCCP) is given. The COPPEF (Computer Program for Parabolic and Elliptic Flow) SFCC performance prediction is described. Fuel pyrolysis in SFCCs is addressed. Experimental facilities for SFC are described. Theoretical and experimental results of the SFCCP are compared. Spin-offs of the SFCCP are described. Work on the Ramjet Technology Demonstration Program (RTDP) towards a European hypersonic space launch vehicle is reviewed. Research on high speed airbreathing propulsion in Europe is reported to broaden the scope to the multinational scene. For individual titles, see N92-22269 through N92-22277.

N92-22269# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
INTRODUCTION OF THE SOLID FUEL COMBUSTION CHAMBER PROJECT
H. Wittenberg *In its* Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 9-23 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

A survey of some highlights during the eight years of work of the Solid Fuel Combustion Chamber Project (SFCCP) is presented.

Objectives and experimental facilities, some important combustion and propulsion parameters, and theoretical research are discussed. Original objectives of SFCCP are concluded to be fulfilled satisfactorily. ESA

N92-22270# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.
THE COPPEF-MODEL FOR SOLID FUEL COMBUSTION CHAMBER PERFORMANCE PREDICTION
P. J. M. Elands *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 25-51 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

The COPPEF (Computer Program for Parabolic and Elliptic Flows) computer code is described. The equations on which the code is based are treated and the various combustion models, which are implemented in the COPPEF code, are discussed and compared. The computational model, which describes in which way the conservation equations are transformed to a set of equations which can be solved numerically, and the required inlet and boundary conditions are discussed. The procedure to solve the system of equations numerically is addressed. The use of COPPEF on different computer systems is discussed, and some examples of calculations and applications of the code are given. The COPPEF code is concluded to be a powerful tool in the prediction of solid fuel ramjet combustion chamber performance. ESA

N92-22271# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
FUEL PYROLYSIS IN SOLID FUEL COMBUSTION CHAMBERS
J. P. deWilde *In its* Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 53-72 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

To describe the regression of solid fuels like polyethylene, only monomer formation and a fixed, temperature-independent value for the effective heat of gasification are assumed. From literature, it is found that in reality during the pyrolysis of solid fuels, not only monomer is formed, but also the composition of the pyrolysis product varies with the heating rate and the temperature. This leads to varying values for the effective heat of gasification. A model describing the pyrolysis of solid fuels in more detail was developed. This model gives a relation between the regression rate and the pyrolysis temperature of the solid fuel. Furthermore, it gives the composition of the pyrolysis products and the effective heat of gasification of the solid fuel at the pyrolysis temperature. The pyrolysis model was implemented into a solid fuel ramjet computational fluid dynamics prediction computer code and allows for the variation of the effective heat of gasification as a function of the combustion conditions as well as a function of the position along the fuel grain. Calculated regression rates were compared with experimental findings. The application of the model has increased the prediction of the regression rates, in particular at high air mass flow rates. This means that an independent model is now available for regression rate prediction, instead of using arbitrarily chosen pyrolysis temperatures and effective heats of gasification. ESA

N92-22272# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.
EXPERIMENTAL FACILITIES FOR SOLID FUEL COMBUSTION CHAMBER RESEARCH **c14**
F. Dijkstra and T. Wijchers *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 73-101 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

A large facility available to perform solid fuel combustion chamber experiments is described. The facility consists of a large indoor rocket test stand. A computer operated connected pipe facility supplies several gases to an experimental solid fuel ramjet. The diagnostics techniques available, which comprise equipment for the measurement of several important parameters for combustion research, such as (instantaneous) values of fuel regression, flow velocities, combustion temperatures and species concentration, are described. ESA

N92-22273# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
COMPARISON OF THEORETICAL AND EXPERIMENTAL RESULTS OF THE SOLID FUEL COMBUSTION CHAMBER PROJECT
B. T. C. Zandbergen *In its* Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 103-127 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

A computer model which simulates the processes in a Solid Fuel Combustion Chamber (SFCC) is reviewed. This model is intended to provide assistance in the design of SFCC's for, for example, ramjet or hybrid rocket propulsion. Experimental data obtained from numerous SFCC experiments are used as a basis. The determination of whether the model is capable of predicting SFCC performance adequately or to focus on the modeling improvements required to arrive at a valid model is addressed. ESA

N92-22274# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.
RAMJET APPLICATIONS OF THE SOLID FUEL COMBUSTION CHAMBER
R. G. Veraar *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 129-146 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

Application studies were performed to investigate the feasibility of the solid fuel ramjet combustion cycle at very high flight speeds. Two different vehicles with specific missions were considered: a ramjet assisted kinetic energy penetrator and a high speed air-to-air missile. A simple method, based on the net thrust/drag ratio, is presented to make an assessment of the performance potential of both HTPB (Hydroxyl Terminated Polybutadiene)-fuelled vehicles over a wide range of flight Mach numbers. The performance of the propulsion system of both vehicles is investigated in more detail at realistic flight conditions, both theoretically and experimentally. The results show that a constant velocity flight of a ramjet assisted kinetic energy penetrator seems to be possible at a sea level Mach 4 flight condition without the use of complex fuel or grain geometry. However, improvement of the fuel performance and/or adaptation of the fuel grain is required for the air-to-air missile to perform a Mach 4 sustained flight. It must be noted that some assumptions made in the presented theoretical application studies, especially with respect to the method of drag calculation, were not validated experimentally for the vehicle geometries considered. ESA

N92-22275# Prins Maurits Lab. TNO, Rijswijk (Netherlands). Rocket Propulsion Section.
SPIN-OFFS OF THE SOLID FUEL COMBUSTION CHAMBER PROJECT
P. A. O. G. Korting *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 147-170 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

Activities emerging from the SFCC project, which can be denoted as spin-off, are shown. In this respect, the role of the so-called Users Committee is discussed. The activities concerned may be classified into the following categories: programs, products, and services which all have in common that they are initiated, generated, or made possible as a result of the SFCC research program. Programs include the development and production of pyrotechnic devices for Ariane 5 and a ramjet kinetic energy

generator feasibility study. Products include the sonic control and measuring choke equipment for gas massflow control and measurements, ultrasonic pulsed echo interface measurement system equipment to measure local instantaneous regression rate of an ablating solid fuel, explosion prevention, and the REAGAS code to simulate the basic mechanism of a gas explosion. Services include integral rocket ramjet tests and aerodynamic heating tests. Aspects of international cooperation emerging from SFCC are discussed. ESA

N92-22276# National Aerospace Lab., Amsterdam (Netherlands). Propulsion Aerodynamics and Acoustics Dept.
RAMJET TECHNOLOGY DEMONSTRATION PROGRAM c07
W. B. deWolf *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 171-182 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

Work on the so-called Ramjet Technology Demonstration Program (RTDP) should enable the Dutch industry and the research institutes to obtain the expertise to participate in the development, manufacture and testing of a future European hypersonic space launch vehicle. The background of such a vehicle is reviewed and illustrated by the Saenger space transportation system which is currently studied in Germany. A possible role for the Dutch industry is argued and it is indicated how the RTDP should bring it to a position to take responsibility for such a role. ESA

N92-22277# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
HIGH SPEED AIRBREATHING PROPULSION IN EUROPE Abstract Only
H. Grieb *In* Technische Univ., Symposium on High Speed Airbreathing Propulsion: The Solid Fuel Combustion Chamber and Beyond 1991 p 183 (For primary document see N92-22268 13-20)
Avail: NTIS HC/MF A09

A comparative outline of the aspects favoring the two-stage horizontally launched space transport vehicle over multi-stage rockets and single-stage horizontally launched space transport vehicles is given. The significant key data for the Saenger space vehicle are discussed. The resulting technical requirements for the propulsion systems are explained with emphasis being placed on the propulsion system of the lower stage, since this represents the greatest technological challenge. Because of the high level of integration, the entire propulsion system, consisting of intake, actual engine and expansion ramp behind the engine, is covered. On this basis, the propulsion concepts taken into consideration for the lower stage up to this point are compared, in retrospect, with regard to their performance as well as the technical and technological problems. The key technologies involved which are presently being pursued are discussed. In this context, the requirements for a technology flight demonstrator, which will become indispensable for the further development of Saenger, and the associated problems are discussed. Based on the information available, apparent development trends and activities in the hypersonic propulsion field in the other European countries are commented on. ESA

N92-22590*# Calspan-Buffalo Univ. Research Center, NY.
HEAT TRANSFER AND PRESSURE MEASUREMENTS AND COMPARISON WITH PREDICTION FOR THE SSME TWO-STAGE TURBINE Interim Report
M. G. Dunn and J. Kim Mar. 1992 120 p
(Grant NAG3-581)
(NASA-CR-190164; NAS 1.26:190164; CUBRC-6401) Avail: NTIS HC/MF A06 CSCL 21H

Time averaged Stanton number and surface pressure distributions are reported for the first stage vane row, the first stage blade row, and the second stage vane row of the Rocketdyne Space Shuttle Main Engine (SSME) two-stage fuel-side turbine. Unsteady pressure envelope measurements for the first blade are also reported. These measurements were made at 10 percent, 50 percent, and 90 percent span on both the pressure and suction surfaces of the first stage components. Additional Stanton number measurements were made on the first stage blade platform, blade tip, and shroud, and at 50 percent span on the second vane. A shock tube was used as a short duration source of heated and pressurized air to which the turbine was subjected. Platinum thin film heat flux gages were used to obtain the heat flux measurements, while miniature silicon diaphragm flush-mounted pressure transducers were used to obtain the pressure measurements. The first stage vane Stanton number distributions are compared with predictions obtained using a version of STAN5 and quasi-3D Navier-Stokes solution. This same quasi-3D N-S code was also used to obtain predictions for the first blade and the second vane. Author

N92-22592*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
ORBIT TRANSFER ROCKET ENGINE TECHNOLOGY PROGRAM: ADVANCED ENGINE STUDY Final Report
C. M. Erickson 28 Feb. 1992 84 p
(Contract NAS3-23773)
(NASA-CR-187215; NAS 1.26:187215; RI/RD-90-180) Avail: NTIS HC/MF A05 CSCL 21H

In Task D.6 of the Advanced Engine Study, three primary subtasks were accomplished: (1) design of parametric data; (2) engine requirement variation studies; and (3) vehicle study/engine study coordination. Parametric data were generated for vacuum thrusts ranging from 7500 lbf to 50,000 lbf, nozzle expansion ratios from 600 to 1200, and engine mixture ratios from 5:1 to 7:1. Failure Modes and Effects Analysis (FMEA) was used as a departure point for these parametric analyses. These data are intended to assist in definition and trade studies. In the Engine Requirements Variation Studies, the individual effects of increasing the throttling ratio from 10:1 to 20:1 and requiring the engine to operate at a maximum mixture ratio of 12:1 were determined. Off design engine balances were generated at these extreme conditions and individual component operating requirements analyzed in detail. Potential problems were identified and possible solutions generated. In the Vehicle Study/Engine Study coordination subtask, vehicle contractor support was provided as needed, addressing a variety of issues uncovered during vehicle trade studies. This support was primarily provided during Technical Interchange Meetings (TIM) in which Space Exploration Initiative (SEI) studies were addressed. Author

N92-23093*# Stuttgart Univ. (Germany, F.R.). Inst. fuer Raumfahrtsysteme.
HIGH POWER ARCJET Progress Report No. 4, Feb. 1991 - Feb. 1992
T. M. Goelz, M. Auweter-Kurtz, H. L. Kurtz, and H. O. Schrade Mar. 1992 24 p
(Grant NAGw-1736)
(NASA-CR-190238; NAS 1.26:190238; IRS-92-P4) Avail: NTIS HC/MF A03 CSCL 21H

In this period a new mass flow controller was brought into the gas supply system, so that the upper limit for the mass flow rate could be increased up to 500 mg/s with hydrogen. A maximum specific impulse of 1500 s could be achieved with the high powered arcjet (HIPARC) at an efficiency of slightly better than 20 percent. Different nozzle throat diameters had been tested. The 100 kilo-watt input power limit was reached with the 4 mm nozzle throat diameter at a mass flow rate of 400 mg/s. Tests were carried out with different cathode gaps and with three different cathodes. In addition measurements of pressure and gas temperature were taken in the feed line in order to determine the pressure drop in the propellant injectors. Author

N92-23104*# Sverdrup Technology, Inc., Brook Park, OH.
PLUG NOZZLES: THE ULTIMATE CUSTOMER DRIVEN PROPULSION SYSTEM Final Report
Carl A. Aukerman Aug. 1991 24 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASEE Previously announced

in IAA as A91-45794
(Contract NAS3-25266)
(NASA-CR-187169; E-6445; NAS 1.26:187169; AIAA-91-2208)
Avail: NTIS HC/MF A03 CSCL 21H

This paper presents the results of a study applying the plug cluster nozzle concept to the propulsion system for a typical lunar excursion vehicle. Primary attention for the design criteria is given to user defined factors such as reliability, low volume, and ease of propulsion system development. Total thrust and specific impulse are held constant in the study while other parameters are explored to minimize the design chamber pressure. A brief history of the plug nozzle concept is included to point out the advanced level of technology of the concept and the feasibility of exploiting the variables considered in this study. The plug cluster concept looks very promising as a candidate for consideration for the ultimate customer driven propulsion system. Author

N92-22360*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE SOLAR ARRAY MODULE PLASMA INTERACTIONS EXPERIMENT (SAMPIE): SCIENCE AND TECHNOLOGY OBJECTIVES
G. Barry Hillard *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 650-654 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10B

N92-22362*# Phillips Lab., Hanscom AFB, MA.
PASP PLUS: AN EXPERIMENT TO MEASURE SPACE-ENVIRONMENT EFFECTS ON PHOTOVOLTAIC POWER SUBSYSTEMS
Donald A. Guidice *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 662-668 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10B

N92-22363*# Physical Sciences, Inc., Andover, MA.
SOLAR CELL ARCING: THE ROLE OF OUTGASSING AND CONTAMINATION Abstract Only
W. J. Marinelli, B. D. Green, B. L. Upschulte, G. Weyl, D. Hastings, and E. Aifer (Boston Univ., MA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 669 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10B

N92-22384*# Science Applications International Corp., Glendora, CA.
A COMPARISON OF SHUTTLE VERNIER ENGINE PLUME CONTAMINATION WITH CONTAM 3.4 CODE PREDICTIONS Abstract Only
Carl R. Maag, Thomas M. Jones, Shankar M. Rao, and W. Kelly Linder (Space Systems Div. AFSC Field Office, Houston, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 789 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 21H

23 CHEMISTRY AND MATERIALS (GENERAL)

N92-22787# Quaid-i-Azam Univ., Islamabad (Pakistan). Dept. of Chemistry.
REACTION OF SOME BETA-DIKETONES WITH SPECIAL REFERENCE TO PHENOLIC COMPOUNDS M.S. Thesis
N. Kausar 1991 108 p
(PB92-133594; NYO-90687) Avail: NTIS HC/MF A06 CSCL 07A

A 1-(2-hydroxyphenyl) 3-(4-substituted phenyl) propane 1,3-dione was prepared by the Baker-Venkataraman reaction. A 2-(2-hydroxyphenyl) 4-(4-substituted phenyl 1,5-benzodiazepines, 1-H-3 (2-hydroxyphenyl) 5-(4-substituted phenyl) pyrazoles, and 1 phenyl 3-(2-hydroxyphenyl) 5-(4-substituted phenyl) pyrazole derivatives were prepared starting from phenolic beta diketone and o-phenyl-enediamine, hydrazine, and phenyl hydrazine respectively. The products were characterized spectroscopically. All compounds were subjected to antifungal test against three fungi, Aspergillus, Fusarium, and Rhizopus, and some of the compounds had shown antifungal activity against these fungi.
Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials*.

N92-22102# Cercom, Inc., Vista, CA.
DEVELOPMENT, FABRICATION, AND BALLISTIC TESTING OF NEW, NOVEL LOW-COST HIGH PERFORMANCE BALLISTIC MATERIALS Final Report, 1 Oct. 1988 - 30 Sep. 1990
Richard Palicka and Jack Rubin Oct. 1991 64 p
(Contract DAAL03-88-C-0032)
(AD-A244472; ARO-26163.1-MS-A) Avail: NTIS HC/MF A04 CSCL 11/2

The program goal was to develop improved low cost high performance ballistic armor ceramic materials through microstructural control. The system Al2O3 + SiC particulates was investigated by varying the type, purity, and particle sizes of the starting material and the volume percentages of the SiC dispersed phase. Low cost as well as high cost starting materials were investigated. Physical, mechanical, and microstructural data was obtained. The study determined that low cost starting materials appear to work as well as high cost materials and that an inexpensive Al2O3-SiC composite containing only 10 v/o SiC could perform as well as sintered alpha silicon carbide as a ceramic ballistic armor. GRA

N92-22154 Pennsylvania State Univ., University Park.
EFFECTS OF TAPE PLACEMENT ON THE MECHANICAL BEHAVIOR OF A GRAPHITE/PEEK COMPOSITE Ph.D. Thesis
Mohamed Nabil Kallas 1991 196 p
Avail: Univ. Microfilms Order No. DA9204228

The effect is studied of modern tape placement technique on the mechanical behavior of APC-2 thermoplastic composite. Reconsolidation of the fabricated panels was performed to study the extent of improvement this procedure has on the mechanical behavior of tape placed materials. Mechanical testing of the as-wound and post-consolidated panels was performed under various environmental conditions that practically simulate the typical flight climate. The effects of temperature and moisture content on the tests are also determined. Experimental results of APC-2 were used for developing a general criterion capable of predicting failure of APC-2 composite under any three-dimensional state of stress. Results of the experimental study strongly suggest that tape placement is a viable alternative for the manufacturing of production scale structures which would be difficult, and more expensive, to produce using other manufacturing techniques. The prediction of the proposed polynomial criterion is shown to be very sensitive to the value of the transverse interaction term. The prediction of the developed criterion correlates reasonably well with the experimental observations of a bolt bearing joint. Dissert. Abstr.

N92-22246# Army Natick Research and Development Command, MA.
STATIC ANALYSES OF ORTHOTROPIC AND NONLINEAR PRESSURE-LOADED MEMBRANES Final Technical Report, Oct. 1988 - Sep. 1991

John C. Brewer Dec. 1991 42 p
(DA Proj. 1L1-62786-A-427)
(AD-A245054; NATICK/TR-92/018) Avail: NTIS HC/MF A03
CSCL 11/4

Analytical finite element studies were conducted for geometrically nonlinear pressure loaded membranes. The membranes were composed of either orthotropic glass/epoxy composite materials or materially nonlinear (bilinear) aluminum. Quarter symmetry was assumed for the rectangular and square membranes. Half symmetry and appropriate side boundary conditions were used for the infinitely long membrane. The models employed simply supported boundary conditions at the membrane edges. Nonlinearities were treated by breaking the loading into small discrete steps. The geometry, stiffness matrix, and pressure loading were recomputed after each step. Elastically linear models exhibited cubic load deflection behavior. That is, the pressure needed to produce a given deflection was proportional to the deflection cubed. The load-deflection behavior of the aluminum model was cubic until yielding and nearly linear thereafter. The ultimate strength of each glass/epoxy membrane was determined using the Tsai-Wu failure criterion. Results imply that composite fabric plies with the fibers oriented in the principle directions of the membrane are the most efficient. The bilinear aluminum model indicates that metal membranes are promising, but post yielding behavior should be investigated experimentally. GRA

N92-22284*# Battelle Memorial Inst., Columbus, OH.
INELASTIC DEFORMATION OF METAL MATRIX COMPOSITES. PART 1: PLASTICITY AND DAMAGE MECHANISMS Final Report
B. S. Majumdar and G. M. Newaz Mar. 1992 67 p
(Contract NAS3-26053)
(NASA-CR-189095; NAS 1.26:189095) Avail: NTIS HC/MF A04
CSCL 11D

The deformation mechanisms of a Ti 15-3/SCS6 (SiC fiber) metal matrix composite (MMC) were investigated using a combination of mechanical measurements and microstructural analysis. The objectives were to evaluate the contributions of plasticity and damage to the overall inelastic response, and to confirm the mechanisms by rigorous microstructural evaluations. The results of room temperature experiments performed on 0 degree and 90 degree systems primarily are reported in this report. Results of experiments performed on other laminate systems and at high temperatures will be provided in a forthcoming report. Inelastic deformation of the 0 degree MMC (fibers parallel to load direction) was dominated by the plasticity of the matrix. In contrast, inelastic deformations of the 90 degree composite (fibers perpendicular to loading direction) occurred by both damage and plasticity. The predictions of a continuum elastic plastic model were compared with experimental data. The model was adequate for predicting the 0 degree response; however, it was inadequate for predicting the 90 degree response largely because it neglected damage. The importance of validating constitutive models using a combination of mechanical measurements and microstructural analysis is pointed out. The deformation mechanisms, and the likely sequence of events associated with the inelastic deformation of MMCs, are indicated in this paper. Author

N92-22299*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CARBON-CARBON MATERIALS AND COMPOSITES
John D. Buckley, ed. and Danny D. Edie, ed. (Clemson Univ., SC.) Washington Feb. 1992 287 p
(NASA-RP-1254; L-16872; NAS 1.61:1254) Avail: NTIS HC/MF A13 CSCL 11D

Carbon-fiber-reinforced carbon matrix (carbon-carbon) composites have received increasing emphasis over the past 15 years. These materials have been used primarily in the aerospace and automotive industries. Carbon-carbon composites can be made in a wide variety of forms from one- to n-dimensional, using unidirectional tows, tapes, or woven cloth. Because of the multiformity, their mechanical properties can be readily tailored. Carbon materials have high strength and stiffness potential, as well as high thermal and chemical stability in inert environments. However, these material systems must be protected with coatings and/or surface sealents when used in an oxidizing environment. Papers discussing the major areas of expertise relating to carbon-carbon materials and composite fabrication are presented. Topics presented are fiber manufacture and design, coatings, and applications of carbon-carbon composites. Author

N92-22321 Texas Univ., Arlington.
DELAMINATION ANALYSIS OF A LAMINATED COMPOSITE TAPERED BEAM Ph.D. Thesis
Yiefan King 1991 253 p
Avail: Univ. Microfilms Order No. DA9131750

A laminated composite tapered beam subjected to tension and bending is investigated for the interlaminar stress distribution and strain-energy-release rate due to effects of ply dropoff and free-edge using finite element and sublaminate analyses. The tapered laminate consists of an S2/SP250 glass epoxy with a plus or minus 45 degree group of plies dropped in one distinct step, 20 ply-thicknesses apart, thus forming a taper angle of 5.71 degrees. The laminate is finite-element modeled in longitudinal and edge view cross-sections. Steep gradients of interlaminar stresses suggest the existence of stress singularities at the points of material and geometric discontinuities created by the internal plydrops. Results suggest that the delamination initiating at the taper root will be self arresting if applied load remains unchanged. Sensitivity analysis of the interlaminar normal stress and total strain energy release rate is investigated for variations of taper angle as well as ply orientation. Results indicate that the interlaminar normal stress is more sensitive at the taper root for a given change in taper angle. Both interlaminar normal stress and total strain energy release rate are more sensitive for variations in the outer ply angle change than in other locations. It is also found that the degree of sensitivity due to bending is much less. Dissert. Abstr.

N92-22385 Ohio State Univ., Columbus.
A STRESS-BASED THEORY DESCRIBING THE DYNAMIC BEHAVIOR OF LAMINATED PLATES Ph.D. Thesis
Gregory Alan Schoeppner 1991 278 p
Avail: Univ. Microfilms Order No. DA9130551

A static laminate plate theory based on an assumed through-the-thickness inplane stress distribution was extended to include inertia effects. The out-of-plane shear and normal stress components were derived from the three-dimensional equations of motion, resulting in six non-zero stress components. Hamilton's variational principle was used to derive the plate equations of motion, the plate constitutive relationships, and the interface continuity equations. The governing equations were rewritten in a self-adjoint form with respect to the convolution bilinear mapping. A set of boundary conditions consistent with the self-adjoint governing field equations was derived. The system of equations for a single lamina consist of 23 field equations. For the laminate system, the mixed formulation enforces both traction and displacement continuity at lamina interfaces while satisfying layer equilibrium. A governing functional was derived for the laminate system on the self-adjoint and consistent boundary operator matrices. The first variation of the governing functional vanished if and only if the governing equations, the boundary conditions, and the jump discontinuity conditions and the initial conditions were identically satisfied. A finite element formulation based on a specialized form of the governing functional was developed. The results of a static analysis of a free-edge delamination coupon specimen were found to be in excellent agreement with published results. The results of a free vibration analysis of a three-layer simply-supported plate were compared to an exact solution.
Dissert. Abstr.

N92-22396# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: MATERIALS SCIENCE
19 Mar. 1992 58 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-92-004) Avail: NTIS HC/MF A04

A bibliography is given of Central Eurasian research in materials science. Topics covered include analysis and testing, coatings, composite materials, corrosion, ferrous and nonferrous metals, alloys, brazes, solders, welding, brazing, soldering, metallurgy, and mining. Author

N92-22401# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: MATERIALS SCIENCE
25 Feb. 1992 66 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-92-002) Avail: NTIS HC/MF A04

A bibliography is given of Central Eurasian research in materials science. Topics covered include analysis and testing, nonmetallic materials, industrial production methods, welding, brazing, soldering, metallurgy, and mining. Author

N92-22402# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: MATERIALS SCIENCE
16 Mar. 1992 52 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-92-003) Avail: NTIS HC/MF A04

A bibliography is given of Central Eurasian research in materials science. Topics covered include analysis and testing of metals, crystal growth, metallurgy, radiation effects, mining and production engineering. Author

N92-22485*# Illinois Inst. of Tech., Chicago.
TEMPERATURE EFFECTS ON HIGH STRAIN RATE PROPERTIES OF GRAPHITE/EPOXY COMPOSITES Final Contractor Report, 1 Feb. 1984 - 30 Jun. 1985
G. Yaniv, I. M. Daniel, S. Cokeing, and G. M. Martinez Dec. 1991 370 p
(Grants NAG3-423; IIT-5-54601)
(NASA-CR-189082; NAS 1.26:189082) Avail: NTIS HC/MF A16 CSCL 11D

A unidirectional graphite epoxy material (AS4/3501-6) was characterized at strain rates ranging from 5 x 10(exp 6) s(exp -1) to 5(exp -1), at room temperature and at 128 C. Results are presented in the form of stress-strain curves to failure. The longitudinal properties remain nearly unchanged with strain rate and temperature. The transverse modulus increases with strain rate but decreases with temperature. The transverse strength and transverse ultimate tensile strain have a positive rate sensitivity at low rates, which changes to negative at intermediate rates and returns to positive rate sensitivity at the highest rates tested. A temperature-time equivalence principle was applied and master curves were obtained for the transverse mechanical properties. The in-plane shear modulus and in-plane shear strength have a positive rate sensitivity. The ultimate intralaminar shear strain has a positive rate sensitivity at low rates, which changes to negative at high rates. At the elevated temperature of 128 C, the ultimate shear strain is 25 to 30 percent higher than the room temperature value, but its strain rate dependence is moderate. Author

N92-22633# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
TEMPORAL DISPERSION IN CHIRAL COMPOSITE MATERIALS: A THEORETICAL STUDY
A. H. Sihvola May 1991 32 p
(PB92-142025; ISBN-951-22-0643-9; Rept-94) Avail: NTIS HC/MF A03 CSCL 11D

The paper focuses on the frequency dependence of electromagnetic parameters of heterogeneous chiral materials. The material parameter of primary interest is the chirality parameter kappa in the constitutive relations adopted. Chiral Maxwell-Garnett mixing rule for spherical inclusions is used to determine the macroscopic composite chirality. To take into account the dispersion, the Condon model is used for the frequency dependence of the chiral component, which is embedded in the nonchiral background medium. All other material parameters are kept constant within this region of chiral dispersion. Illustrations show the effect of the mixing process on the characteristics of the chiral dispersion, both in the real and imaginary parts of kappa. It is shown that due to mixing, the chirality will become spread to a broader frequency range, and acquire more structure in the dispersion curve. These changes are naturally functions of the parameters of the mixture. GRA

N92-22637*# Lockheed Aeronautical Systems Co., Burbank, CA.
MANUFACTURING DEVELOPMENT OF PULTRUDED COMPOSITE PANELS Final Report
L. E. Meade Apr. 1989 58 p
(Contract NAS1-15069)
(NASA-CR-181780; NAS 1.26:181780) Avail: NTIS HC/MF A04 CSCL 11D

The weight savings potential, of graphite-epoxy composites for secondary and medium primary aircraft structures, was demonstrated. One of the greatest challenges facing the aircraft industry is to reduce the acquisition costs for composite structures to a level below that of metal structures. The pultrusion process, wherein reinforcing fibers, after being passed through a resin bath are drawn through a die to form and cure the desired cross-section, is an automated low cost manufacturing process for composite structures. The Lockheed Aeronautical Systems Company (LASC) Composites Development Center designed, characterizated materials for, fabricated and tested a stiffened cover concept compatible with the continuous pultrusion process. The procedures used and the results obtained are presented. Author

N92-22639*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA. LANGLEY RESEARCH CENTER DRY POWDER TOWPREG SYSTEM
Robert M. Baucom and Joseph M. Marchello Apr. 1990 50 p
(NASA-TM-102648; NAS 1.15:102648) Avail: NTIS HC/MF A03

Dry powder polymer impregnated carbon fiber tows were produced for preform weaving and composite materials molding applications. In the process, fluidized powder is deposited on spread tow bundles and melted on the fibers by radiant heating to adhere the polymer to the fiber. Unit design theory and operating correlations were developed to provide the basis for scale up of the process to commercial operation. Special features of the operation are the pneumatic tow spreader, fluidized bed, resin feeder, and quality control system. Bench scale experiments, at tow speeds up to 50 cm/sec, demonstrated that process variables can be controlled to produce weavable LARC-TPI carbon fiber towpreg. The towpreg made by the dry powder process was formed into unidirectional fiber moldings and was woven and molded into preform material of good quality. Author

N92-22967*# Florida Univ., Gainesville. Dept. of Aerospace Engineering.
INDENTATION-FLEXURE AND LOW-VELOCITY IMPACT DAMAGE IN GRAPHITE/EPOXY LAMINATES
Young S. Kwon and Bhavani V. Sankar Mar. 1992 171 p
(Grant NAG1-826)
(NASA-CR-187624; NAS 1.26:187624) Avail: NTIS HC/MF A08 CSCL 11D

Static indentation and low velocity impact tests were performed on quasi-isotropic and cross ply graphite/epoxy composite laminates. The load deflection relations in static tests and impact force history in the impact tests were recorded. The damage was assessed by using ultrasonic C-scanning and photomicrographic techniques. The static behavior of the laminates and damage progression during loading, unloading, and reloading were explained by a simple plate delamination model. A good correlation existed between the static and impact responses. It was found that results from a few static indentation-flexture tests can be used to predict the response and damage in composite laminates due to a class of low velocity impact events. Author

N92-23097# Indian Inst. of Tech., Bombay. Dept. of Civil Engineering.
COMPUTATION OF TRANSVERSE/INTERLAMINAR STRESSES IN FIBRE REINFORCED COMPOSITE AND SANDWICH LAMINATES Final Report
B. S. Manjunatha and Tarun Kant Mar. 1992 266 p
(Grant Aero/RD-134/100/10/88-89/534)
(IIT-B/CE/RR/92/1) Avail: NTIS HC/MF A12

A simple C degree isoparametric finite element formulation based on a set of high order theories is projected to provide a reliable prediction for transverse and interlaminar stresses in layered composite and sandwich laminates. These theoretical and computational models are based on the Taylor's series expansion of the displacements and incorporate the laminate deformations which account for the effects of transverse shear deformation, transverse normal stress/strain and a nonlinear variation of inplane displacements with respect to the thickness coordinate, thus eliminating the need for the use of shear correction coefficients. The inplane stresses are evaluated by using constitutive relations. The transverse and interlaminar stresses are evaluated by using three dimensional elasticity equilibrium equations. The integration of these equations is attempted through finite difference techniques and a new approach called an exact surface fitting method. The formulation for symmetric and unsymmetric laminates have been dealt with separately so as to achieve economy in computation. The accuracy, efficiency, and versatility of the high order theories have been demonstrated by comparing the present results with the available elasticity and closed form solutions. The transverse/interlaminar stresses obtained by exact surface fitting methods are better compared to the equilibrium and finite difference methods. The numerical results for symmetric and unsymmetric sandwich laminates are also presented which can be used for future reference. Author

N92-23102*# Lockheed Engineering and Sciences Co., Hampton, VA.
FINITE ELEMENT ANALYSIS OF THE STIFFNESS OF FABRIC REINFORCED COMPOSITES
R. L. Foye Feb. 1992 137 p
(Contract NAS1-19000)
(NASA-CR-189597; NAS 1.26:189597) Avail: NTIS HC/MF A07 CSCL 11D

The objective of this work is the prediction of all three dimensional elastic moduli of textile fabric reinforced composites. The analysis is general enough for use with complex reinforcing geometries and capable of subsequent improvements. It places no restrictions on fabric microgeometry except that the unit cell be determinate and rectangular. The unit cell is divided into rectangular subcells in which the reinforcing geometries are easier to define and analyze. The analysis, based on inhomogeneous finite elements, is applied to a variety of weave, braid, and knit reinforced composites. Some of these predictions are correlated to test data. Author

N92-22513*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE POLYMER MATRIX COMPOSITES
Michael A. Meador *In its* Aeropropulsion 1987 Feb. 1990 p 45-54 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11D

N92-22515*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF A NEW GENERATION OF HIGH-TEMPERATURE COMPOSITE MATERIALS
P. K. Brindley *In its* Aeropropulsion 1987 Feb. 1990 p 65-78 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11D

N92-22677*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ADVANCED COMPOSITE MATERIALS AND PROCESSES
Robert M. Baucom *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 3-11 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

N92-22678*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RTM: COST-EFFECTIVE PROCESSING OF COMPOSITE STRUCTURES
Greg Hasko (Lockheed Engineering and Sciences Co., Hampton, VA.) and H. Benson Dexter *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 12-21 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

N92-22679*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A LOW COST METHOD OF TESTING COMPRESSION-AFTER-IMPACT STRENGTH OF COMPOSITE LAMINATES
Alan T. Nettles *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 22-31 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

N92-22728*# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
ADVANCED COMPOSITE APPLICATIONS FOR SUB-MICRON BIOLOGICALLY DERIVED MICROSTRUCTURES
J. M. Schnur, R. R. Price, P. E. Schoen, Joseph Bonanventura, and Douglas Kirkpatrick (Science Applications International Corp., McLean, VA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 469-479 Sponsored in part by ONR; Office of Naval Technology; DARPA; and NSF (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

N92-22762*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPOSITE OVERWRAPPED NICKEL-HYDROGEN PRESSURE VESSELS
John Reagan and Joe Lewis (TRW, Inc., Redondo Beach, CA.) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 471-484 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-22176# Oak Ridge Y-12 Plant, TN.
APPLICATIONS OF FOURIER TRANSFORM INFRARED SPECTROSCOPY TO SURFACE ANALYSIS PROBLEMS 2
G. L. Powell and M. Milosevic (Harrick Scientific, Inc., Ossining, NY.) 25 Sep. 1991 43 p Presented at the 17th Department of Energy (DOE) Surface Studies Conference, Livermore, CA, 15-18 Oct. 1991
(Contract DE-AC05-84OS-21400)
(DE92-006668; Y/DZ-748/R1; CONF-9110322-1-Vugraphs)
Avail: NTIS HC/MF A03

Applications of infrared spectroscopy to surface analysis are described in terms of the combined use of a number of techniques to solve specific surface analysis problems involving both qualitative and quantitative analysis of surface species. Emphasis is placed

on the characterization of both the substrate and the surface species and the application of this to the monitoring of surface processes and the inspection of manufactured items. Lithium hydride has been studied using remote analysis by diffuse reflectance in glove boxes containing very pure argon or controlled moisture levels with robot-operated gravimetric monitoring. These experiments are supported by internal reflectance and diffuse reflectance measurements in spectrometer sample compartments to characterize the reactants. Beryllium oxide has been studied using an evacuable diffuse reflectance cell to determine the effects of vacuum baking reexposure to moisture on the surface hydroxyl species. Diffuse reflectance and emission measurements have been used to monitor the curing and reaction of environmental gases with composite materials such as graphite-expoxy structures. A direct comparison of diffuse reflectance and emission spectra was done using a barrel ellipsoid diffuse reflectance/emission detector and the Spectropus Optical Transfer System. Grazing-incidence external-reflectance with p-polarized light was used to study the oxidation in room air of polished uranium coupons. The absorption band at 570/cm was used to monitor the extent of oxidation with a resolution of approximately one monolayer of UO2 and to distinguish the parabolic, linear, and breakaway corrosion domains. External reflectance is compared with diffuse reflectance as a method for stain analysis and for measuring the effects of H2O in UO2 corrosion films. DOE

N92-22202 California Univ., Berkeley.
EXPERIMENTAL STUDIES OF THE EFFECT OF GRAVITY ON THE STABILITY OF PREMIXED LAMINAR FLAMES Ph.D. Thesis
Corey Martin Dunsky 1991 312 p
Avail: Univ. Microfilms Order No. DA9203552

An experimental study of the effect of gravity on the stability of premixed laminar flames was conducted. In the experiments, premixed propane hydrogen nitrogen were observed under varying conditions including normal gravity, low pressure, and low gravity. Results of the burner flame experiments indicate that heat loss from the flame to the burner plays a dominant role in the characteristics of the cellular structure, overwhelming buoyancy effects. Consequently, in most cases, few changes in cell characteristics are observed in low gravity. Further, when burner flame structure does change in reduced gravity, the observations can largely be explained by changes in the flow field external to the premixed flames, rather than inherent effects of buoyancy on the stability of the flame. However, results of the tube experiments indicate that once the stabilizing effects of burner heat loss are removed, the effects of buoyancy on flame stability and structure are significant. Interesting dynamic behavior is observed in low gravity for both planar and cellular tube flames. Flat flames become curved toward the unburned gas, while wrinkled flames show larger, more irregular cellular structure. These results are in qualitative agreement with theoretical predictions. Dissert. Abstr.

N92-22409# Technische Univ., Delft (Netherlands).
AN ELECTROCHEMICAL STUDY OF SILICON/BORON PHOSPHIDE HETEROJUNCTION PHOTOELECTRODES Ph.D. Thesis
Albertus Petrus Leon Goossens 1991 199 p Sponsored by Netherlands Foundation for Scientific Research
(ETN-92-91138) Avail: NTIS HC/MF A09

An experimental study of structural, optical, and electronic properties of silicon/boron phosphide heterojunctions in aqueous electrolytes, for the purpose of energy conversion processes, is presented. Studies on the following are given: growth and characterization of chemical vapor deposition coatings of amorphous and crystalline boron phosphide; impedance of surface recombination at illuminated semiconductor electrodes (a nonequilibrium approach); space charge capacitance of nondegenerate semiconductors with shallow and deep impurity levels; polycrystalline boron phosphide semiconductor electrodes; structural, optical and electronic properties of silicon/boron phosphide heterojunction photoelectrodes; and an impedance study on boron phosphide semiconductor electrodes. ESA

N92-22417# Technische Univ., Delft (Netherlands).
ELECTROPHILIC AROMATIC ACYLATION Ph.D. Thesis
Jacobus Jan Scheele 1991 207 p Sponsored by Netherlands Organization for the Advancement of Pure Research
(ETN-92-91166) Avail: NTIS HC/MF A10

A study to gain further insight and to develop alternatives to solve one of the main drawbacks of the Friedel-Crafts (FC) acylation, that is, the large amounts of catalyst required without possible reuse, is presented. On an industrial scale, problems are encountered because of waste water disposal upon hydrolysis of the product ketone catalyst complex. The possible use of minor amounts of metal chloride catalyst in acylations requires a more fundamental insight into the mechanisms of the reaction. Supportive research is described for the eventual development of an environmentally friendly FC acylation procedure by the screening of a large number of metal chloride catalysts; the search for conditions under which complexation of the catalyst with the acylating reagent with respect to product ketone is favored; a close investigation of the nature of catalyst to product ketone complexation; a kinetic investigation of the acylation reaction; and the study of alternative catalysts like (poly)phosphoric acid and some heterogeneous materials. ESA

N92-22418# Technische Univ., Delft (Netherlands).
CHEMICAL ASPECTS OF DRINKING WATER CHLORINATION Ph.D. Thesis
Ruud Johannes Bernha Peters 1991 129 p
(ETN-92-91167) Avail: NTIS HC/MF A07

The nature and extent of the reaction of chlorine with organic substances in water, and the consequences of this reaction, are described. The aqueous chlorination of cyanoacetic acid is described. A method to analyze dihaloacetonitriles (DHANs) together with the better known and more frequently measured trihalomethanes (THMs) was developed. Results of a study of the chlorination of proteins and the protein fraction of humic material are presented. A method to analyze haloacetic acides (HAAs) is described. Chlorine disinfected drinking water is known to contain the Ames-mutagen 3 chloro 4 (dichloromethyl) 5 hydroxy 2(5H) furanine (MPX). It is demonstrated that 3 dihyroxybenzaldehyde is an efficient precursor for MX and its geometric isomer EMX. A possible pathway for their formation was suggested. Results in the study of the chlorination of humic acid on the presence of bromide are presented. ESA

N92-22459*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AMBIENT-TEMPERATURE CO-OXIDATION CATALYSTS
Billy T. Upchurch, David R. Schryer, Kenneth G. Brown, and Erik J. Kielin (Old Dominion Univ., Norfolk, VA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 308-316 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 07D

N92-22481*# Biotronics Technologies, Inc., Wauwatosa, WI.
TWO NEW ADVANCED FORMS OF SPECTROMETRY FOR SPACE AND COMMERCIAL APPLICATIONS
Kenneth J. Schlager *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 507-514 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 07D

N92-22482*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A COATED-WIRE ION-SELECTIVE ELECTRODE FOR IONIC CALCIUM MEASUREMENTS
John W. Hines, Sara Arnaud, Marc Madou, Jose Joseph, and Arvind Jina (Teknekron Sensor Development Corp., Menlo Park, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 515-522 (For primary document see N92-22423

13-99)
Avail: NTIS HC/MF A23 CSCL 07D

N92-22697*# Naval Research Lab., Washington, DC.
THE MICROASSAY ON A CARD: A RUGGED, PORTABLE IMMUNOASSAY
David Kidwell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 183-190 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

N92-22698*# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
DETECTION OF SMALL MOLECULES WITH A FLOW IMMUNOSENSOR
Anne W. Kusterbeck and Frances S. Ligler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 191-196 Sponsored in part by FAA and United States Customs Service (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

N92-22724*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WATER QUALITY MONITOR (EMPAX INSTRUMENT)
Warren C. Kelliher, Ben Clark, and Mike Thornton (Martin Marietta Corp., Denver, CO.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 437-444 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

N92-22726*# Naval Weapons Center, China Lake, CA. Chemistry Div.
CALCIFICATION PREVENTION TABLETS
Geoffrey A. Lindsay, Michael A. Hasting, and Michael A. Gustavson (Naval Sea Systems Command, Bremerton, WA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 452-458 Sponsored in part by Commanders Naval Air Forces US Atlantic and Pacific Fleet (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

N92-22727*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATED CARBON DIOXIDE CLEANING SYSTEM
David T. Hoppe *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 459-465 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

N92-22730*# Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
CRYOGENIC FOCUSSING, OHMICALLY HEATED ON-COLUMN TRAP
Stephen R. Springston *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 486-494 (For primary document see N92-22676 13-99)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC/MF A22 CSCL 07D

N92-22731*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
XPS STUDY OF THE EFFECT OF HYDROCARBON CONTAMINATION ON POLYTETRAFLUOROETHYLENE (TEFLON) EXPOSED TO ATOMIC OXYGEN
Morton A. Golub, Theodore Wydeven, and Robert D. Cormia (Surface Science Labs., Mountain View, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 495-499 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-22146# Technology Information, Forecasting and Assessment Council, New Delhi (India).
TITANIUM: A MATERIAL FOR THE FUTURE
Nov. 1990 10 p
(PB92-125103; TIFAC:P:006/G) Avail: NTIS HC/MF A02
CSCL 11F

It is essential for India to proceed ahead with the 1000 tpy titanium sponge plant immediately. All preparatory work has been completed. In addition, it is essential to stabilize the initial off-take of the metal from this plant through specific commitments by some of the major sectors like the power sector, chemical industries, and aerospace industries. Detailed techno-market surveys should be conducted in terms of applications in other areas, including certain mass consumption items. Export possibilities for the finished metal and products should also be explored, as India is abundant in the mineral. Value added in the metal and its products is high. In all these efforts, it is beneficial that Indian industries take a special interest, since the metal possesses a number of unique possibilities. Author

N92-22156 Cincinnati Univ., OH.
A UNIFIED CONSTITUTIVE MODEL FOR THE THERMOMECHANICAL FATIGUE RESPONSE OF A NICKEL BASE SUPERALLOY RENE 80 Ph.D. Thesis
Viswanath Shivakumar Bhattachar 1991 253 p
Avail: Univ. Microfilms Order No. DA9205412

Described here is the development of a nonisothermal constitutive model to predict the thermomechanical fatigue (TMF) response of a nickel base superalloy, Rene 80. Nonisothermal deformation mechanisms and temperature history effects are modeled using state variables. The isothermal constitutive model developed by Ramaswamy and Stouffer was chosen as a starting point, since it could predict the tensile, creep, and fatigue response of Rene 80 successfully at several temperatures. However, the TMF response could be predicted only approximately. The flow equation of the Ramaswamy-Stouffer model was re-written in the form of an Arrhenius equation with explicit temperature dependence. The model parameters were recalculated, and the isothermal predictions were correlated with the data at five test temperatures between 538 C and 1093 C. Thus, both the deformation mechanisms in Rene 80 were modeled successfully by the constitutive equations. Material parameters were verified using isothermal and nonisothermal tensile calculations at intermediate temperatures. The revised isothermal model was also able to predict the initial TMF response successfully using parameter identification. Dissert. Abstr.

N92-22222# Los Alamos National Lab., NM.
SHOCK COMPRESSION OF IRON
R. S. Hixson and J. N. Fritz 1991 3 p Presented at the 1991 American Physical Society (APS) Conference on Shock Compression of Condensed Matter, Williamsburg, VA, 17-20 Jul. 1991
(Contract W-7405-eng-36)
(DE92-007437; LA-UR-91-173; CONF-9107105-58) Avail: NTIS HC/MF A01

New high-pressure Fe Hugoniot data are obtained. We interpret these and previous data to indicate a transition to a liquid phase in the single shock Hugoniot of Fe. DOE

N92-22295# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Materials Processing and Powder Metallurgy.
THERMODYNAMIC ANALYSIS OF THE BINARY SYSTEM COPPER-ZIRCONIUM
R. Luoma and J. Talja 23 May 1991 14 p
(PB92-136472; TKK-V-B61; ISBN-951-22-0659-5) Avail: NTIS HC/MF A03 CSCL 11F

The thermodynamic properties and the phase diagram of the binary system Cu-Zr were critically assessed by the Lukas program, which simultaneously used thermodynamic and phase diagram measurements. The assessed binary phase diagram was in agreement with that found in the literature. The number of stable stoichiometric intermetallic compounds was found to be six. The model parameters optimized for the alloy phases using the Lukas program were transformed for use in the program Thermo-calc. The phase diagram calculated using Thermo-calc was similar to that calculated by the Lukas program. The complete and internally consistent Gibbs energy expressions for the alloy phases were presented allowing calculation of the phase diagram and the thermodynamic properties of the phases. GRA

N92-22318# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: MATERIALS SCIENCE
4 Feb. 1992 59 p Transl. into ENGLISH of various Russian articles
(JPRS-UMS-92-001) Avail: NTIS HC/MF A04

A bibliography of Central Eurasian materials science research is given. Topics covered include analysis and testing, coatings, composite materials, corrosion, ferrous metals, nonmetallic materials, production engineering, metallurgy, mining, and metal working. Author

N92-22404# National Aeronautical Lab., Bangalore (India).
ANALYSIS OF TRACE AMOUNTS OF LEAD TIN AND CADMIUM IN ZINC-DIE-CAST BY DC POLAROGRAPHY
S. Sreepathy, Aithu Poojary, and S. R. Rajagopalan Dec. 1990 13 p
(NAL-PD-MT-9019) Avail: NTIS HC/MF A03

An alloy that contains lead, tin, and cadmium as trace impurities is discussed. DC polarography is used for estimation of lead, tin, and cadmium. Lead and tin yield a combined wave. Techniques for differentiating between the lead and the tin waves are given. Author

N92-22407*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OXIDATION CHARACTERISTICS OF BETA-21S IN AIR IN THE TEMPERATURE RANGE 600 TO 800 C
Terryl A. Wallace, Ronald K. Clark, and Karl E. Wiedemann (Analytical Services and Materials, Inc., Hampton, VA.) Mar. 1992 10 p Presented at the 7th World Conference on Titanium, San Diego, CA, 28 Jun. - 2 Jul. 1992
(NASA-TM-104217; NAS 1.15:104217) Avail: NTIS HC/MF A02 CSCL 11F

The metastable beta-Ti alloy Beta-21S, Ti-15Mo-2.7Nb-3Al-0.2Si (weight percent), has been proposed as a candidate for use in metal matrix composites in future hypersonic vehicles. The present study investigated the oxidation behavior of Beta-21S over the temperature range 600 C to 800 C. Oxidation weight gain was evaluated using thermogravimetric analysis. Oxidized specimens were evaluated using x ray diffraction techniques, scanning electron microscopy, energy dispersive x ray analysis, and electron microprobe analysis to identify oxidation products and evaluate oxidation damage to the alloy. Author

N92-22739# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
NEUTRON DIFFRACTION STUDIES OF THE NUCLEAR MAGNETIC PHASE DIAGRAM OF COPPER
A. J. Annila, K. N. Clausen, A. S. Oja, J. T. Tuoriniemi, and H. Weinfurter May 1991 53 p Prepared in cooperation with Risoe National Lab., Roskilde, Denmark; and Hahn-Meitner-Inst. G.m.b.H., Berlin, Fed. Republic of Germany
(PB92-142439; TKK-F-A685; ISBN-951-22-0625-0) Avail: NTIS HC/MF A04 CSCL 11F

The authors have studied spontaneous antiferromagnetic (AF) order in the nuclear spin system of copper by neutron diffraction experiments at nanokelvin temperatures. Copper is a model system for the nearest neighbor dominated spin-3/2 fcc antiferromagnet. The phase diagram has been investigated by measuring the magnetic field dependence of the (100) reflection, characteristic for a type-1 AF structure, and of a completely new Bragg peak (0 2/3 2/3), which has not been observed previously in an fcc antiferromagnet. The results suggest the presence of high-field (100) phases at 0.12 less than or equal to B less than or equal to B(sub c) approx. = 0.26 mT, for B along either the (100) or (011) crystalline axes, intermediate-field (0 2/3 2/3) structures around B = 0.09 mT for all field directions, and a zero-field (100) phase. No reflection corresponding to a high-field phase for B parallel (111) has been found. Recent theoretical work has yielded results in agreement with our experimental data. GRA

N92-23080# Technische Univ., Delft (Netherlands).
METALLIC STRUCTURES WITH REDUCED DIMENSIONS
Johannes Romijn 1991 146 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(ETN-92-91191) Avail: NTIS HC/MF A07

The superconducting properties of thin films and narrow wires are studied in view of pushing the limits of fabrication technology to smaller critical dimensions extending over large areas. Fabrication technology of metallic structures with small lateral dimensions is studied. High voltage electron beam lithography and nanolithography with scanning electron microscopes are considered. Magnetoresistance and electron-phonon scattering in aluminum films is studied. Inelastic scattering rate and superconducting phase coherence in aluminum strips are discussed. For individual titles, see N92-23081 through N92-23090.

N92-23081# Technische Univ., Delft (Netherlands). Center for Submicron Technology.
NANOMETER-SCALE LITHOGRAPHY FOR LARGE LATERAL STRUCTURES **c35**
Johannes Romijn and E. vanderDrift *In its* Metallic Structures with Reduced Dimensions 1991 p 11-26 Repr. from Physica B, v. 152, 1988 p 14 Presented at NATO Advanced Research Workshop on Coherence in Superconducting Networks, Delft, Netherlands (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

Nanometer scale lithography for structures with large overall dimensions is investigated. Such work requires an electron beam lithography tool with high resolution capabilities and high positioning accuracy. The specific properties of commercially available electron beam pattern generators and of a modified scanning transmission electron microscope are presented. Good anisotropic etching facilities are identified as crucial to complement the exposure process. A review of high resolution mask techniques is presented and practical examples are illustrated. ESA

N92-23082# Technische Univ., Delft (Netherlands). Centre for Submicron Technology.
TUNGSTEN CALIBRATION MARKERS FOR ELECTRON BEAM PATTERN GENERATORS **c35**
D. A. vanLeeuwen, R. J. M. vanVucht (Nederlandse Philips Bedrijven B.V., Eindhoven.), Johannes Romijn, and E. vanderDrift *In its* Metallic Structures with Reduced Dimensions 1991 p 27-36 Repr. from Proceedings Micro Circuit Engineering Conference 1988 (Amsterdam, Netherlands, North Holland Publishing), 1989 p 247 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

Tungsten markers fabricated by Reactive Ion Etching (RIE) using a trilevel resist stencil as a mask are described. A low pressure SF6 plasma is used for etching the tungsten. The influence of metal layer thickness and the type of substrate on the performance

of the marker in automatic calibration is investigated. Spot sizes smaller than 40 nm are measured. The effective width of the marker edge is shown to be about 30 nm. At 50 keV beam energy, the contrast of the markers on carbon is shown to be considerably better than that of the markers on silicon substrates. ESA

N92-23083# Technische Univ., Delft (Netherlands). Inst. for Microelectronics and Submicron Technology.
EXPERIMENTAL STUDY ON PROXIMITY EFFECTS IN HIGH VOLTAGE E-BEAM LITHOGRAPHY c35
E. Boere, E. vanderDrift, Johannes Romijn, and B. Rousseeuw *In its* Metallic Structures with Reduced Dimensions 1991 p 37-46 Repr. from Proceedings Micro Circuit Engineering Conference 1989, Cambridge, England (Amsterdam, Netherlands, North Holland Publishing), 1990 p 351-354 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

The importance of knowing the proximity exposure effect for accurate realization of e (electron) beam lithography patterns is discussed. An experimental study on proximity effects is presented with exposure conditions and substrate systems typical to those used in high resolution lithography. Single and multlayer masks are submitted to exposures at an acceleration voltage of 50 or 100 kV in both Si and substrate layers with a different atomic number. Significant deviations from the two-Gaussian model are observed. ESA

N92-23084# Technische Univ., Delft (Netherlands).
NANOLITHOGRAPHY WITH ELECTRON MICROSCOPES c35
In its Metallic Structures with Reduced Dimensions 1991 p 47-54 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

The use of a Philips Scanning Electron Microscope (PSEM) 500 in making ultra small devices is described. The PSEM 500 is equipped with a pattern generator. Accurate adjustment of the beam is essential for good results. To overcome the poor signal to noise ratio in secondary electron detection mode, a solid state transmission detector is used which requires a thin membrane. Both astigmatism and focus can be adjusted accurately and minimum feature sizes as small as 25 nm are readily obtained. ESA

N92-23085# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
ANALYSIS OF MAGNETORESISTANCE DATA ON ALUMINUM
Johannes Romijn, J. G. F. Kablau, T. M. Klapwijk (Groningen Rijksuniv., Netherlands), and J. E. Mooij *In its* Metallic Structures with Reduced Dimensions 1991 p 57-62 Repr. from Springer Proceedings in Physics (Berlin, Fed. Republic of Germany, Springer-Verlag), v. 28, 1987 p 194 Presented at Tokyo Univ. International Symposium on Anderson Localization (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

Use of the Brenig rather than the Larkin theory of weak localization in analyzing magnetoresistance data of superconducting materials at large magnetic fields is studied. Comparison of inelastic scattering times obtained with the two methods shows differences of only a few percent. In the magnetic field region a reasonable description of the magnetoresistance data is achieved by including the Maki-Thompson term in the Brenig theory. A four fold improvement is seen when including this term. The self energy contributions appear to be about two times too large. ESA

N92-23086# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
ELECTRON-PHONON SCATTERING RATES IN DIRTY THREE-DIMENSIONAL ALUMINUM FILMS
Johannes Romijn, R. M. G. Boesten, T. M. Klapwijk (Groningen Rijksuniv., Netherlands), and J. E. Mooij *In its* Metallic Structures with Reduced Dimensions 1991 p 63-69 Repr. from Springer Proceedings in Physics (Berlin, Fed. Republic of Germany, Springer-Verlag), v. 28, 1987 p 198 Presented at Tokyo Univ. International Symposium on Anderson Localization (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

Inelastic scattering rates for electrons in three dimensional aluminum films are measured in a regime where the electron-photon scattering dominates the electron-electron scattering. The mean free path is varied and the temperature dependence of the electron-phonon scattering rate is studied. A crossover from T(3) is observed. The data fails to yield a T(4) dependence as predicted by Schmid for very dirty material. ESA

N92-23087# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
CRITICAL PAIR-BREAKING CURRENT IN SUPERCONDUCTING ALUMINUM STRIPS FAR BELOW T(SUB c)
Johannes Romijn, T. M. Klapwijk, M. J. Renne, and J. E. Mooij *In its* Metallic Structures with Reduced Dimensions 1991 p 71-86 Repr. from Phys. Rev. B, v. 26, 1982 p 3648 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

Critical currents of narrow, thin aluminum strips are measured as a function of temperature. For the smallest samples uniformity of the current density is obtained over a large temperature range. The intrinsic limit on the current carrying capacity of the superconductor is therefore measured outside the Ginzburg-Landau regime. Experimental values are compared with predictions developed by Kupriyanov and Lukichev. An approximate method for solving their equations is presented. The results of these approximations are within 1 pct. of the exact solution. Experimental data is shown to be in excellent agreement with theoretical predictions. ESA

N92-23088# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
INELASTIC SCATTERING RATE FOR ELECTRONS IN THIN ALUMINUM FILMS DETERMINED FROM THE MINIMUM FREQUENCY FOR MICROWAVE STIMULATION OF SUPERCONDUCTIVITY
P. C. vanSon, Johannes Romijn, T. M. Klapwijk, and J. E. Mooij *In its* Metallic Structures with Reduced Dimensions 1991 p 87-95 Repr. from Phys. Rev. B, v. 29, 1984 p 1503 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

A method for determining the inelastic scattering rate for electrons in thin films is presented. The method uses the minimum frequency for microwave enhancement of the critical pair breaking current. Measurements on clean aluminum films with thicknesses between 4 to 144 nm yield excellent agreement with the predictions of Abrahams et al for electron-electron scattering. Comparison of values for electron-phonon interaction in disordered thin films and in three dimensional disordered metals is presented. ESA

N92-23089# Technische Univ., Delft (Netherlands). Dept. of Applied Physics.
SUPERCONDUCTING PHASE COHERENCE IN VERY WEAK ALUMINIUM STRIPS
A. J. vanRun, Johannes Romijn, and J. E. Mooij *In its* Metallic Structures with Reduced Dimensions 1991 p 97-103 Repr. from Jap. J. of Appl. Phys., v. 26, Suppl. 26-3, 1987 p 1765 Presented at International Conference on Low Temperature Physics, Kyoto, Japan, 1987 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

In one dimensional superconductors phase coherence is broken by phase slip events. In the usual strips used, the resultant resistance is too small to be measured except in an extremely narrow temperature range near critical temperature. Strips with small cross sections and very small mean free path are studied. Quantitative comparison with theory is possible over a wide temperature range with such strips. Current is passed through the strips and the probability distribution for switching in the dissipative

state is determined. Results partly agree with predictions for localized occurrence of thermally activated phase slip. ESA

N92-23090# Technische Univ., Delft (Netherlands). Inst. of Microelectronics and Submicron Technology.
MACROSCOPIC QUANTUM TUNNELING IN SUPERCONDUCTING AMORPHOUS NbSi WIRES
Johannes Romijn, M. N. Webster, H. S. J. vanderZant, C. J. P. M. Harmans, and J. E. Mooij *In its* Metallic Structures with Reduced Dimensions 1991 p 105-126 Submitted for publication (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

Phase slip rates in very weak amorphous NbSi wires are studied. The resistive transitions and probability distributions of the switching current into the normal state are measured. Extreme sensitivity to external interference noise is demonstrated and shielding of the sample to avoid such influence is achieved. The probability distributions of the current for switching into the normal state show crossover from a temperature dependent width of the distribution into a constant width. The phase slip rates obtained from these distributions show deviation from the rates predicted by the model for thermally activated phase slip. ESA

N92-23107# Ames Lab., IA.
MECHANICAL SPECTROSCOPY AND QUANTITATIVE NONDESTRUCTIVE EVALUATION OF METALLIC MATERIALS
O. Buck and D. O. Thompson 1991 57 p Presented at the International Summer School on Mechanical Spectroscopy, Cracow (Poland), Sep. 1991
(Contract W-7405-eng-82)
(DE92-006580; IS-M-693; CONF-9109337-1) Avail: NTIS HC/MF A04

This paper presents a short overview of materials characterization and flaw detection, from both the mechanical spectroscopy and the nondestructive evaluation points of view. Both viewpoints are aimed at the same objective, i.e., to characterize the material in terms of some inhomogeneity or flaw. A number of these are discussed, including interstitials, precipitates, dislocations, grain boundaries, interfaces, porosity, and cracks in metals and alloys. Of special interest is the role of these defects on the overall performance of the material. DOE

N92-22371*# Case Western Reserve Univ., Cleveland, OH. Dept. of Physics.
SPUTTERING OF IONS FROM Cu AND Al BY LOW ENERGY OXYGEN ION BOMBARDMENT Abstract Only
T. G. Eck, L.-Y. Chen, and R. W. Hoffman *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 716 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 11F

N92-22444*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NOVEL APPLICATIONS FOR TAZ-8A
Stephen M. Riddlebaugh and William J. Waters *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 171-182 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11F

N92-22445*# National Aeronautics and Space Administration. White Sands Test Facility, NM.
TEST METHODS FOR DETERMINING THE SUITABILITY OF METAL ALLOYS FOR USE IN OXYGEN-ENRICHED ENVIRONMENTS
Joel M. Stoltzfus and Mohan V. Gunaji (Lockheed Engineering and Sciences Co., Las Cruces, NM.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 183-192 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11F

N92-22446*# Ultramet, Pacoima, CA.
A MAJOR ADVANCE IN POWDER METALLURGY
Brian E. Williams, Jacob J. Stiglich, Jr., Richard B. Kaplan, and Robert H. Tuffias *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 193-202 (For primary document see N92-22423 13-99)
(Contract DAAL04-88-C-0030)
Avail: NTIS HC/MF A23 CSCL 11F

N92-22936# Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers (France). Lab. d'Energetique et de Detonique.
DYNAMIC DAMAGE OF ALUMINUM, COPPER, AND IRON TARGETS BY LASER SHOCK: NUMERICAL STUDY OF STEPPED TARGET SPALLATION [ENDOMMAGEMENT DYNAMIQUE PAR CHOC LASER DE CIBLES D'ALUMINIUM, DE CUIVRE ET DE FER: ETUDE NUMERIQUE DE L'ECAILLAGE DE CIBLES A MARCHE]
Francis Cottet, Michel Boustie, and Thibaut deResseguier *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 92-98 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22937# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
RESIDUAL CONSTRAINTS INDUCED BY LASER SHOCK: APPLICATION TO METALLIC STRUCTURE FATIGUE RESISTANCE IMPROVEMENT [CONTRAINTES RESIDUELLES INDUITES PAR CHOC-LASER. APPLICATION A L'AMELIORATION DE LA TENUE EN FATIGUE DES STRUCTURES METALLIQUES]
Patrick Ballard *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 99-104 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N92-22203 Washington Univ., Seattle.
EXPERIMENTAL/NUMERICAL CHARACTERIZATION OF THE DYNAMIC FRACTURE BEHAVIOR OF CERAMIC MATERIALS Ph.D. Thesis
Lyle Ray Deobald 1991 135 p
Avail: Univ. Microfilms Order No. DA9203249

An impact apparatus was developed in which the impactor strikes the end of a rectangular ceramic bar specimen with near perfect squareness at velocities of 5.8, 8.0, and 10.0 m/s. The impactor was identical to the specimen except that it was half the length of the specimen. The impact produced a sudden tension stress after the passage of the compressive wave at the middle of the specimen where a sharp 3mm precrack had previously been introduced. Dynamic fracture experiments were conducted on four ceramic materials. The dynamic fracture initiation toughness, K (sub Id), was consistent with published data for similar materials. The dynamic propagation stress intensity factor, K(sub ID), and the crack velocity, increased with increasing impact velocity. K (sub ID) initiated at the expected value of K (sub Id) and rose to as high as four times K (sub Id). Crack branching occurred in all four materials impacted at 10 m/s, and the hot pressed Al2O3 impacted at 8.9 m/s. Crack branching occurred at roughly 0.4 times the shear wave speed and the dynamic crack branching stress intensity factor, K(sub Ib), was 2 to 2.5 times K(sub Id). The hot pressed Al2O3 and the two composites had essentially the same crack velocities and K(sub ID).

Dissert. Abstr.

N92-22205 Case Western Reserve Univ., Cleveland, OH.
EVALUATION OF AN INNOVATIVE HIGH-TEMPERATURE CERAMIC WAFER SEAL FOR HYPERSONIC ENGINE APPLICATIONS Ph.D. Thesis
Bruce Michael Steinetz 1991 198 p
Avail: Univ. Microfilms Order No. DA9202246

A high temperature seal test fixture was designed and fabricated to measure static seal leakage performance under engine simulated conditions. Ceramic wafer seal leakage rates are presented for engine simulated air pressure differentials up to 100 psi and temperatures up to 1350 F, sealing both flat and distorted wall conditions, where distortions can be as large as 0.15 in. in only an 18 in. span. Seal leakage rates are low, meeting an industry established tentative leakage limit for all combinations of temperature, pressure, and wall conditions considered. A seal leakage model developed from externally pressurized gas film bearing theory is also presented. Predicted leakage rates agree favorably with the measured data for nearly all combinations of temperature and pressure. Discrepancies noted at high temperature pressure and temperature are attributed to thermally induced, non-uniform changes in the size and shape of the leakage gap condition. Dissert. Abstr.

N92-22278*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SCREEN CAGE ION PLATING (SCIP) AND SCRATCH TESTING OF POLYCRYSTALLINE ALUMINUM OXIDE
Talivaldis Spalvins, Harold E. Sliney, and Daniel L. Deadmore Feb. 1992 16 p
(NASA-TM-105404; E-6391; NAS 1.15:105404) Avail: NTIS HC/MF A03 CSCL 11C

A screen cage ion plating (SCIP) technique was developed to apply silver films on electrically nonconducting aluminum oxide. It is shown that SCIP has remarkable throwing power; surfaces to be coated need not be in direct line of sight with the evaporation source. Scratch tests, employing a diamond stylus with a 200 micro m radius tip, were performed on uncoated and on silver coated alumina. Subsequent surface analysis show that a significant amount of silver remains on the scratched surfaces, even in areas where high stylus load produced severe crack patterns in the ceramic. Friction coefficients were lowered during the scratch tests on the coated alumina indicating that this modification of the ion planting process should be useful for applying lubricating films of soft metals to electrical insulating materials. The very good throwing power of SCIP also strongly suggests general applicability of this process in other areas of technology, e.g., electronics, in addition to tribology. Author

N92-22305*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PLASMA ETCHING A CERAMIC COMPOSITE
David R. Hull, Todd A. Leonhardt, and William A. Sanders (Analex Corp., Brook Park, OH.) 1992 12 p Presented at the 24th Annual Convention of the International Metallographic Society, Monterey, CA, 29 Jul. - 1 Aug. 1991
(NASA-TM-105430; E-6846; NAS 1.15:105430) Avail: NTIS HC/MF A03 CSCL 11C

Plasma etching is found to be a superior metallographic technique for evaluating the microstructure of a ceramic matrix composite. The ceramic composite studied is composed of silicon carbide whiskers (SiC(sub W)) in a matrix of silicon nitride (Si3N4), glass, and pores. All four constituents are important in evaluating the microstructure of the composite. Conventionally prepared samples, both as-polished or polished and etched with molten salt, do not allow all four constituents to be observed in one specimen. As-polished specimens allow examination of the glass phase and porosity, while molten salt etching reveals the Si3N4 grain size by removing the glass phase. However, the latter obscures the porosity. Neither technique allows the SiC(sub W) to be distinguished from the Si3N4. Plasma etching with CF4 + 4 percent O2 selectively attacks the Si3N4 grains, leaving SiC(sub W) and glass in relief, while not disturbing the pores. An artifact of the plasma etching reaction is the deposition of a thin layer of carbon on Si3N4, allowing Si3N4 grains to be distinguished from SiC(sub W) by back scattered electron imaging. Author

N92-22322 Wisconsin Univ., Madison.
AN ANALYTIC AND EXPERIMENTAL INVESTIGATION OF THE RHEOLOGY AND INTERFACIAL MECHANICAL BEHAVIOR OF CERAMIC COMPOSITES Ph.D. Thesis
Dallas W. Meyer 1990 154 p
Avail: Univ. Microfilms Order No. DA9111394

The purpose of this research is to evaluate the high temperature mechanical response of the fiber matrix interface in ceramic composites. This thesis introduces a new technique for evaluating and quantifying the mechanical response of these interfaces by comparing experiments to analytical simulations of bulk composite rheologic behavior. A decomposition of the displacement and stress fields of a composite specimen subjected to an off-axis loading allows the simulation of the creep and load relaxation by integrating a generalized two-dimensional boundary value problem in time. The model incorporates nonlinear viscoelasticity in the matrix and a penalized incremental plasticity formulation for contact friction at the fiber-matrix interface. A Newton-Raphson solution scheme and a singular yield surface provision is developed for combining the effects of viscoelasticity and idealized Coulomb friction. The model solution predicts the existence of a steady-state stress field and strain rate for the composite, which is a function of fiber orientation angle, the viscosity and stress exponent of the matrix, and the friction coefficient of the interface. Experimentally, the creep and load relaxation response of CaAl2Si2O8 glass ceramic and the same material reinforced with 30 percent volume fraction SiC fibers is characterized. The stress deformation behavior of the matrix along with several other experimental observations indicate the primary deformation mechanisms of the matrix are diffusion at low stresses and mechanical twinning/dislocation glide at higher stresses. Dissert. Abstr.

N92-22486*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
POLYMER INFILTRATION STUDIES Progress Report, 31 Dec. 1991 - 31 Mar. 1992
Joseph M. Marchello Apr. 1992 82 p
(Grant NAG1-1067)
(NASA-CR-190204; NAS 1.26:190204) Avail: NTIS HC/MF A05 CSCL 11C

Progress was made in several areas on the preparation of carbon fiber composites using advanced polymer resins. Polymer infiltration studies dealt with ways of preparing composite materials from advanced polymer resins and carbon fibers. This effort is comprised of an integrated approach to the process of composite part fabrication. The goal is to produce advanced composite materials for automated part fabrication using textile and robotics technology in the manufacture of subsonic and supersonic aircraft. The object is achieved through investigations at the NASA Langley Research Center and by stimulating technology transfer between contract researchers and the aircraft industry. Covered here are literature reviews, a status report on individual projects, current and planned research, publications, and scheduled technical presentations. Author

N92-22593*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SHORTCOMINGS IN GROUND TESTING, ENVIRONMENT SIMULATIONS, AND PERFORMANCE PREDICTIONS FOR SPACE APPLICATIONS
E. G. Stassinopoulos and G. J. Brucker (General Electric Co., West Long Branch, NJ.) Apr. 1992 18 p
(NASA-TP-3217; NAS 1.60:3217; Rept-92B00001) Avail: NTIS HC/MF A03 CSCL 22D

This paper addresses the issues involved in radiation testing of devices and subsystems to obtain the data that are required to predict the performance and survivability of satellite systems for extended missions in space. The problems associated with space environmental simulations, or the lack thereof, in experiments

intended to produce information to describe the degradation and behavior of parts and systems are discussed. Several types of radiation effects in semiconductor components are presented, as for example: ionization dose effects, heavy ion and proton induced Single Event Upsets (SEUs), and Single Event Transient Upsets (SETUs). Examples and illustrations of data relating to these ground testing issues are provided. The primary objective of this presentation is to alert the reader to the shortcomings, pitfalls, variabilities, and uncertainties in acquiring information to logically design electronic subsystems for use in satellites or space stations with long mission lifetimes, and to point out the weaknesses and deficiencies in the methods and procedures by which that information is obtained. Author

N92-22624*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DELAMINATION BEHAVIOR OF QUASI-ISOTROPIC GRAPHITE EPOXY LAMINATES SUBJECTED TO TENSION AND TORSION LOADS
J. A. Hinkley and T. K. OBrien Jan. 1992 17 p Presented at the American Helicopter Society Specialists' Meeting, Williamsburg, VA, 1991 Prepared in cooperation with Army Aviation Systems Command, Hampton, VA
(NASA-TM-104181; NAS 1.15:104181; AVSCOM-TR-91-B-018) Avail: NTIS HC/MF A03 CSCL 11B

Sixteen and thirty-two ply quasi-isotropic laminates fabricated from AS4/3501-6 were subjected to pure tension, simultaneous tension and torsion, and torsion fatigue. Layups tested were (45 sub n/-45 sub n/O sub n/90 sub n) sub s, with n = 2 or 4. A torsion damage pattern consisting of a localized matrix crack and delaminations was characterized, and the measured torsional stiffnesses were compared with calculated values. It was found that a combination of tension and torsion led to failure at smaller loads than either type of deformation acting alone. Further work is required to determine the exact form of the failure criterion. Author

N92-22666*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE MECHANICAL PROPERTIES OF POLYIMIDE FILMS AFTER EXPOSURE TO HIGH pH
Catharine I. Croall and Terry L. St.Clair Jan. 1992 33 p
(NASA-TM-104202; NAS 1.15:104202) Avail: NTIS HC/MF A03 CSCL 11C

Wiring failures linked to insulation damage have drawn much attention in the aerospace industry and concerns have developed regarding the stability and safety of polyimide insulated electrical wire. Several polyimides were selected for evaluation for resistance to degradation by various aqueous alkaline solutions. The polyimides under evaluation include commercially available films such as Kapton (tk), Apical (tk), LaRC(tk)-TPI, and Upilex(tk)R and S, as well as a number of experimental films prepared by NASA Langley. Thermally imidized films were studied for their retention of mechanical properties after exposure to high pH solutions under stressed conditions. Author

N92-22737# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
DYNAMICS OF (119)SnCl4 LIQUID MOLECULES IN POROUS GLASS
J. Hietaniemi, E. Ikonen, and T. Katila Feb. 1991 17 p
(PB92-142272; TKK-F-A679; ISBN-951-22-0527-0) Avail: NTIS HC/MF A03 CSCL 11C

Dynamics of SnCl4 molecules confined in pores of Vycor glass is studied using Mossbauer spectroscopy. Novel data on the temperature dependence of the recoilless fraction below and above the bulk freezing point T(0) = 240 K are presented. The results show unambiguously the existence of the Mossbauer effect (ME) in the liquid regime, i.e., above T(0). This indicates the collective motion of molecule groups which normally obliterates the ME in the liquid phase is prevented in porous glass. A theoretical description of the confined liquid dynamics is presented and compared with experimental data. GRA

N92-23106# MSE, Inc., Butte, MT.
CERAMIC FABRICATION R/D Final Technical Progress Report
1991 64 p
(Contract DE-AC07-88ID-12735)
(DE92-006548; DOE/ID-12735/T21) Avail: NTIS HC/MF A04

The goal of this project was to develop the cohesive ceramic fabrication (CCF) process and to demonstrate its application to various defense-related systems. The CCF process involves a binder system that yields a green ceramic having rubbery yet plastic and tacky properties. The tackiness allows green parts to be pressed together with light (hand) pressure, and the bond is maintained through firing. Fabrication of complex parts is possible via the assembly of simple shapes, easily fabricated by plastic forming and followed by firing to produce a ceramic bond. For some applications, this approach offers substantial potential cost savings over more conventional methods. Other possibilities include the potential for fabrication of ceramic parts having graded properties and fabricating ceramic matrix composites. DOE

N92-22424*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CERAMIC SUSCEPTOR FOR INDUCTION BONDING OF METALS, CERAMICS, AND PLASTICS
Robert L. Fox and John D. Buckley *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 3-9 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

N92-22460*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HIGH TEMPERATURE ADHESIVES
Terry L. St.Clair *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 319-326 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11A

N92-22461*# Naval Research Lab., Washington, DC.
FLUORINATED EPOXY RESINS WITH HIGH GLASS TRANSITION TEMPERATURES
James R. Griffith *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 327-329 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

N92-22462*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POLYIMIDES CONTAINING PENDENT SILOXANE GROUPS
John W. Connell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 330-338 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

N92-22463*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CORROSION-PROTECTIVE COATINGS FROM ELECTRICALLY CONDUCTING POLYMERS
Karen Gebert Thompson, Coleman J. Bryan, Brian C. Benicewicz, and Debra A. Wrobleski (Los Alamos National Lab., NM.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 339-347 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

N92-22476*# Naval Weapons Center, China Lake, CA. Chemistry Div.
NONLINEAR OPTICAL POLYMERS FOR ELECTRO-OPTIC SIGNAL PROCESSING
Geoffrey A. Lindsay *In* NASA, Washington, Technology 2001:

The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 463-470 Sponsored in part by ONR (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

N92-22477*# Naval Research Lab., Washington, DC. Chemistry Div.
OPTICAL DATA STORAGE AND METALLIZATION OF POLYMERS
C. M. Roland and M. F. Sonnenschein *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 471-475 Sponsored in part by ONR (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

N92-22516*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SELF-LUBRICATING COATINGS FOR HIGH-TEMPERATURE APPLICATIONS
Harold E. Sliney *In its* Aeropropulsion 1987 Feb. 1990 p 79-90 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11C

N92-22517*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CERAMICS FOR ENGINES
James D. Kiser, Stanley R. Levine, and James A. DiCarlo *In its* Aeropropulsion 1987 Feb. 1990 p 91-103 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 11C

N92-22701*# Brookhaven National Lab., Upton, NY. Physics Dept.
A METHOD OF PRODUCING HIGH QUALITY OXIDE AND RELATED FILMS ON SURFACES
Mark W. Ruckman, Myron Strongin, and Yongli Gao (Rochester Univ., NY.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 215-224 Previously announced as N92-18740 Sponsored in part by Alfred P. Sloan Foundation (For primary document see N92-22676 13-99)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC/MF A22 CSCL 11C

N92-22702*# Naval Research Lab., Washington, DC. Electronics Science and Technology Div.
ADVANCED SILICON ON INSULATOR TECHNOLOGY
D. Godbey, H. Hughes, and F. Kub *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 225-231 Sponsored in part by DNA Prepared in cooperation with ARACOR, Sunnyvale, CA (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11C

N92-22706*# Army Lab. Command, Watertown, MA.
OXYNITRIDE GLASS FIBERS
Parimal J. Patel, Donald R. Messier, and R. E. Rich *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 258-264 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-22234# Quaid-i-Azam Univ., Islamabad (Pakistan). Dept. of Chemistry.
CONCEPTUAL ANALYTICAL PRODUCTION OF HIGH POWER FUEL AND HIGH FIBER PROTEIN THROUGH SENSIBLE SOURCE M.S. Thesis
M. Arshad 1990 196 p
(PB92-133602) Avail: NTIS HC/MF A09 CSCL 07D

The agricultural material (corn, wheat, barley, oat, rye, and molasses) was subjected to fermentation to produce high fiber protein (HFP). The product could be suitable for human consumption. Plus the liquid protein by-product could be used for animal feed and recovery of carbon dioxide from the fermentation vapor. This could be sold as a gas or further processed into dry ice. Ethanol produced was further converted into high power alcohol and its characteristic properties were compared with that of the natural fuel. The high power alcohol was transformed into high power fuel (gellified material) by the interaction of potassium salts of the derivative of carbohydrates with high power alcohol. The high power fuel could be used for household and defense purposes. The fermentation liquid remaining as residue could be consumed as a non-alcoholic drink and used for export. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N92-22286*# Missouri Univ., Rolla. Dept. of Ceramic Engineering.
USE OF MICROGRAVITY TO IMPROVE THE EFFICIENCY AND POWER OUTPUT OF Nd-DOPED LASER GLASSES Final Report, 1 Jul. 1989 - 30 Jun. 1991
Chandra S. Ray 20 Mar. 1992 35 p
(Grant NAG8-779)
(NASA-CR-190230; NAS 1.26:190230) Avail: NTIS HC/MF A03 CSCL 22A

The objectives of this research are to: (1) obtain further evidence and understand the science for the reported improvement in chemical homogeneity in glasses prepared in microgravity; and (2) study the feasibility of improving the optical and fluorescence properties, particularly, the limit for Nd(+3) concentration quenching and threshold energy for laser action for laser glasses prepared in microgravity. Attention was directed to ground based investigation whose primary purpose was to determine the suitability and conditions for processing these laser glasses in space. This report describes that the scientific and technical information required for planning flight experiments for these glasses have been obtained, and the preparation for handling and analyzing post flight samples have also been taken. Instruments required for measuring the fluorescence properties of interest have been constructed. The optical and fluorescence properties for the glasses have been measured and made available for comparative property analysis. H.A.

N92-22392 GKSS-Forschungszentrum Geesthacht (Germany, F.R.). Inst. of Materials Research.
EFFECT OF CRACK DEPTH (a/W) ON WELD METAL FRACTURE TOUGHNESS
M. Kocak, S. Yao, K.-H. Schwalbe, and F. Walter (Fachhochschule, Hamburg, Germany, F.R.) 1990 17 p Repr. from Technology Transfer Series (A. Niku-Lari), Gournay-sur-Marne, France, 1990 p 225-268 Presented at the International Conference Welding-90: Technology, Material, Fracture, Gournay-sur-Marne, France, 1990

(GKSS-91/E/22; ISBN-2-907-669-15-X; ISSN-0344-9629; ETN-92-91202) Copyright Avail: GKSS-Forschungszentrum Geestahcht G.m.b.H

Single Edge Notched Bend (SENB) specimens were prepared from various multipass steel weldments and Crack Tip Opening Displacement (CTOD) tests were carried out at different temperatures. Two specimen geometries, square and rectangular, were used with the a/W ratio ranging from 0.1 to 0.5 to investigate the effect of notch depth on CTOD toughness. The CTOD values at initiation and maximum load for shallow cracked (a/W = 0.1) specimens were found to be significantly higher than for the deep notched specimens. Two CTOD concepts were simultaneously applied to the same specimen. Comparison of the two CTOD results showed a very good agreement between them. The plastic rotation factor was also experimentally determined for shallow cracked specimens and found to be about 0.2. ESA

N92-23064# Space Research Organization Netherlands, Utrecht.

[ACTIVITIES REPORT OF THE SPACE RESEARCH ORGANIZATION NETHERLANDS] Annual Report, 1990

Apr. 1991 223 p

(ETN-92-91189) Avail: NTIS HC/MF A10

The SRON (Space Research Organization Netherlands) annual report is presented. Reports of the board, of the science advisory board, and an executive summary are included. Within the report of the institute, details of the data reduction and interpretation of the projects under development and of research and development at the Space Research Laboratories at Utrecht, Heiden and Groningen are given. Reviews of the funded research are also given. This research looked into the physiological and biological effects of microgravity. Experiments considering Marangoni convection and coagulation in microgravity are also reviewed. Information on the organization, personnel, and finances are also given. For individual titles, see N92-23065 through N92-23079.

N92-23065# Technische Univ., Delft (Netherlands). Faculties of Geodesy/Aerospace Engineering.

EARTH ORIENTED SPACE RESEARCH AT DELFT UNIVERSITY OF TECHNOLOGY Progress Report **c12**

E. Vermaat and K. F. Wakker *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 104-111 (For primary document see N92-23064 13-29)

Avail: NTIS HC/MF A10

A progress report is presented. Activities in the field of Satellite Laser Ranging (SLR) on instrument development, operations and data analysis are covered. In the field of Global Positioning System (GPS), tracking and data analysis are considered, and in the field of satellite radar altimetry data analysis is considered. ESA

N92-23066# Academic Center for Dentistry, Amsterdam (Netherlands) Dept. of Oral Cell Biology.

EFFECT OF MICROGRAVITY AND MECHANICAL STIMULATION ON THE IN VITRO MINERALIZATION AND RESORPTION OF FETAL MOUSE LONG BONES **c51**

J. P. Veldhuijzen and J. J. W. A. vanLoon *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 112-113 Repr. from Proceedings of the 4th International Conference on the WEGENER/MEDLAS project, Scheveningen, Netherlands, 7-9 Jun. 1989, Feb. 1990 p 281-300 (For primary document see N92-23064 13-29)

Avail: NTIS HC/MF A10

Preparations of the IML-1 (International Microgravity Laboratory) mission, the Experiment Sequence Test (EST), the hardware performance during the experiment and the testing of the 130 bar pressurized containers for leakages or pressure increase after the experiment, are considered. Inspection of cultured bones showed that normal growth and mineralization had occurred. In some cases the expected mineralization under compression was absent. Preparations and preliminary experiments for the Bion-10 mission are considered. The aim of this mission is to study histologically the mineralization and resorption of mouse long bones after 3 and 6 days of microgravity. ESA

N92-23067# Hubrecht Lab., Utrecht (Netherlands).

ROLE OF GRAVITY IN THE ESTABLISHMENT OF THE DORSO-VENTRAL AXIS IN THE AMPHIBIAN EMBRYO **c51**

G. A. Ubbels, S. C. J. Kerkvliet, and J. M. Narraway *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 114-117 (For primary document see N92-23064 13-29)

Avail: NTIS HC/MF A10

A project to analyze early Xenopus development is considered. An experiment to take place during the IML-1 (International Microgravity Laboratory) Space Shuttle mission, which considers the role of gravity on the establishment of the spatial structure of the amphibian embryo, is outlined. Problems encountered during the 'Experiment Sequence Test', an obligatory activity of participants of the IML-1 mission are described and solutions given. ESA

N92-23068# Utrecht State Univ. (Netherlands). Dept. of Molecular Cell Biology.

REGULATION OF CELL GROWTH AND DIFFERENTIATION BY MICROGRAVITY **c51**

P. J. Rijken, R. P. deGroot, J. Boonstra, W. Kruijer, A. J. Verkleij, and S. W. deLaat (Hubrecht Lab., Utrecht, Netherlands) *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 118-120 (For primary document see N92-23064 13-29)

Avail: NTIS HC/MF A10

To study the effects of variations in gravity on human cells at the molecular level, the well characterized Epidermal Growth Factor (EGF) induced signal transduction in A431 epidermoid carcinoma cells was used as a model system. The influence of gravity on EGF induced EGF receptor clustering and early gene expression was investigated. The results indicate a gravity dependent modulation of EGF and TPA (12-O Tetradecanoyl Phorbol Acetate) induced signal transduction. However, one of the first cellular responses to EGF, that of EGF receptor clustering appears not to be influenced by altered gravity conditions. Thus, gravity may find its targets intracellulary and not at the level of the plasma membrane. Additional evidence of specific gravity targets in the cell, is the observation that not all intracellular pathways that lead to early gene expression are sensitive to altered gravity conditions. ESA

N92-23069# Amsterdam Univ. (Netherlands). Dept. of Molecular Cell Biology.

EFFECTS OF MICROGRAVITY ON THE PLASMA MEMBRANE-CYTOSKELETON INTERACTIONS DURING CELL DIVISION IN CHLAMYDOMONAS Abstract Only **c51**

H. vandenEnde *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 121 (For primary document see N92-23064 13-29)

Avail: NTIS HC/MF A10

Preparations for an experiment to be flown in the Bion-10 satellite to study the effects of microgravity on cell division in the unicellular green algae Chlamydomonas are considered. The nature of the interaction between the plasma membrane and the microtubules will be investigated by disturbing the properties of the plasma membrane and the polar cellular distribution of the cell division apparatus by microgravity. Reasons for the use of Chlamydomonos are given. ESA

N92-23070# Amsterdam Univ. (Netherlands). Dept. of Molecular Cell Biology.

BACTERIAL PROLIFERATION UNDER MICROGRAVITY CONDITIONS **c51**

C. L. Woldringh and M. A. J. M. vanBakel *In* Space Research Organization Netherlands, Activities Report of the Space Research

Organization Netherlands Apr. 1991 p 122-124 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

Preparations for a study in which the proliferation of Escherichia coli cells under microgravity conditions will be studied are discussed. The hardware for the culturing of the cells, plastic bags with a volume or 700 to 1400 ml, and methods by which growth variation in different bags can be reduced are considered. It is suggested that the bags contain 1400 ml of cell suspension and two ampules, filled with glucose and formaldehyde, respectively. Glucose commences the growth and the formaldehyde enables the cell suspensions to be fixed at the time of sampling. ESA

N92-23071# Amsterdam Univ. (Netherlands). Dept. of Physiology.
CONTROL OF BLOOD PRESSURE IN HUMANS UNDER MICROGRAVITY **c52**
J. M. Karemaker, E. M. Akkerman, M. vanLeeuwen, K. H. Wesseling, J. J. Settels, W. Wieling (Academic Medical Center, Amsterdam, Netherlands), and J. H. A. Dambrink *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 125-128 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

Collaborative studies in the general fields of gravity related physiology, of which microgravity research is becoming an essential part, are discussed. Studies include some of the following: tilt and volume regulation; the measurement of finger blood pressure by fingerpress on a K-135 parabolic flight; measurement of respiration, cardiovascular (particularly brain perfusion) and metabolic responses to microgravity under different levels of exercise; and the development of a mathematical model for the description of the cardiovascular responses to tilt maneuvers. ESA

N92-23072# Amsterdam Univ. (Netherlands). Dept. of Otorhinolaryngology.
THE EFFECT OF MICROGRAVITY ON (1) PUPIL SIZE, (2) VESTIBULAR CALORIC NYSTAGMUS AND (3) THE SWIMMING BEHAVIOUR OF FISH **c51**
W. J. Oosterveld, H. A. A. deJong, and H. W. Kortschot *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 129-131 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

Three projects conducted in parabolic flight are summarized. These include: the effect of linear accelerations on pupil size; study of the horizontal and vertical component of a caloric induced nystagmus; the effect of altered states of gravity on the swimming behavior of fishes. Results of these experiments are given. ESA

N92-23073# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
OTOLITH RESPONSES IN MAN DURING PARABOLIC FLIGHT **c52**
J. T. Marcus *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 131-133 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

An experiment performed to investigate the influence of linear accelerations on the vestibular system, especially in the otoliths of six subjects is outlined. It is concluded that an otolith-ocular pathway modulates optokinetic eye movements in parabolic flight. ESA

N92-23074# Nijmegen Univ. (Netherlands). Dept. of Biochemistry.
CRYSTALLIZATION OF RHODOPSIN IN MICROGRAVITY
W. J. deGrip and F. J. M. Daemen *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 134-136 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

A project aimed at finding optimal crystallization conditions on Earth in order to expose the best chance conditions to microgravity is outlined. The analysis of a large number of parameters such as choice and concentration of rhodopsin preparation, selection of buffer, detergent, precipitant, pH, temperature, and the use of additives is considered. Four reasonably reproducible conditions, restricted at 0.1 pH unit and 1 precipitant, were selected for final modification and evaluation. This involves further subtle changes in type or concentration of additives and/or precipitant. Under the selected conditions small crystals were repeatedly observed. Evaluation of two dimensional order or three dimensional order indicated that these structures were still too inhomogeneous and/or too small to allow high resolution analysis by electron or X ray diffraction. This emphasized the need for microgravity experiments. ESA

N92-23075# Gaubius Inst., Leiden (Netherlands).
CRYSTALLIZATION OF PLASMINOGEN Abstract Only
W. Nieuwenhuizen *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 136 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

In order to study the stability encountered with plasminogen solution, a switch to tissue type Plasminogen Activator (t-PA) is suggested. This enzyme is higly specific for plasminogen, which is in fact the only protein substrate known for t-PA. It is conceivable that t-PA would suffer much less from autodigestion than plasmin, which has a broad specificity. The crystallization of t-PA in microgravity is proposed. ESA

N92-23076# Groningen Rijksuniv. (Netherlands). Dept. of Chemical Engineering.
MARANGONI CONVECTION DUE TO EVAPORATION **c34**
L. P. B. M. Janssen and H. C. J. Hoefsloot *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 137-139 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

The aim was to understand and describe quantitatively Marangoni convection in order to determine its influence on mass transfer processes. The flow and concentration gradients in a well defined model system (acetone in water) in containers with different geometries under microgravity and terrestrial circumstances were studied. Developments in research on Marangoni convection to establish the influence of the actual shape of the interface in the onset of Marangoni convection, induced by the evaporation of acetone from a water/acetone mixture are discussed. As an extension of this research the acetone concentration was investigated in the liquid by means of interferometry. New experiments were performed during parabolic flights in order to record well defined flow patterns in the containers. A cooperation was also started with investigators of protein crystallization under microgravity in order to determine what the influence of fluid flow (Marangoni convection) could be on protein crystallization. ESA

N92-23077# Technische Univ., Eindhoven (Netherlands). Lab. of Colloid Chemistry.
COAGULATION IN MICROGRAVITY Abstract Only
L. L. M. Krutzer and H. N. Stein *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 140 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

The TEXUS 23 experiments confirmed the results of the TEXUS 17 coagulation experiments: the coagulation rate is higher under microgravity than under 1 g conditions; the form of the transmission versus time curves is convex towards the time axis under microgravity, whereas it is concave under 1 g conditions. Possible explanations are: the presence of rest motion at experiment start due to the spin of the rocket during launch or rest motion due to the homogenization procedure; the Brownian coagulation may be faster than combined Brownian and gravity induced coagulation.

The possibility of rest notion at experiment start was checked with experiments on Earth and with the film made of the flow visualization cell during the microgravity experiment: no rest motion was observed. The second possible explanation was checked making use of a computer program. Calculations of trajectories of particles subjected to Brownian forces and gravity were performed and the coagulation rate was calculated. For this system it was found that combined gravity induced and Brownian coagulation was faster than Brownian coagulation. However, calculations can be performed only for spherical particles. The particles used in these experiments were definitely nonspherical. In order to explain these microgravity experiments it would be very promising to perform a microgravity experiment with polystyrene particles (which do not have a density difference with the continuous phase) and with quartz particles in an artificial gravity field. ESA

N92-23078# Amsterdam Univ. (Netherlands). Van der Waals Lab.
DENSITY DISTRIBUTION IN NEAR-CRITICAL FLUIDS
A. C. Michels *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 141-142 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

Preparations of the CPF (Critical Point Facility) MIM experiment on the Spacelab mission IML-1 are given, including details of the hardware (intended to probe the microgravity behavior of near critical sulfurhexafluoride), the EPT (Experiment Parameter Table) construction, and tests of the experiment timeline. Some results of this experiment and another 'g-quench' experiment performed on a parabolic flight are given. It was found that in finite samples relaxation rates are indeed strongly dependent on adiabatic processes. Due to its high compressibility, a critical system will be extremely sensitive to changes in g levels. In a microgravity environment the impact of residual g fluctuations could therefore be significant. ESA

N92-23079# National Aerospace Lab., Amsterdam (Netherlands).
INSTRUMENT DEVELOPMENT FOR THE WET SATELLITE MODEL EXPERIMENT **c35**
J. P. B. Vreeburg *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 142-144 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

The Wet Satellite Model (WSM) is a small spacecraft that is instrumented with linear accelerometers in order to determine its linear and angular acccelerations. From these measurements the motion of the rigid frame that supports the accelerometers can be determined. If the inertial properties (moments of inertia, center of mass position) of the rigid frame are known, the forces and moments that generate a measured motion, can be calculated. In the WSM experiment, these forces and moments are exerted by liquid in a tank that is part of the rigid WSM structure. The performance of an instrument with three orthogonal linear accelerometers was tested during 28 parabolas on a Caravelle airplane. A picture of the test article is given. Information on data collection and calibration of the accelerometers is given. ESA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-22160# ERES Consultants, Inc., Savoy, IL.
INNOVATIVE MATERIALS AND EQUIPMENT FOR PAVEMENT SURFACE REPAIRS. VOLUME 1: SUMMARY OF MATERIAL PERFORMANCE AND EXPERIMENTAL PLANS
K. L. Smith, D. G. Peshkin, E. H. Rmeili, T. VanDam, and K. D. Smith Feb. 1991 221 p Sponsored by Strategic Highway Research Program, Washington, DC
(PB92-135235; SHRP-M/UFR-91-504) Avail: NTIS HC/MF A10; also available in set of 3 reports as HC/MF E99 CSCL 13B

Volume 1 of the three-volume set summarizes the use, performance, and properties of numerous sealing and patching materials used for common maintenance activities, including portland cement concrete (PCC) crack sealing, PCC joint resealing, PCC spall repair, asphalt concrete (AC) crack sealing and filling, and AC pothole repair. The report also discusses four experimental plans developed for testing promising materials. GRA

N92-22161# ERES Consultants, Inc., Savoy, IL.
INNOVATIVE MATERIALS AND EQUIPMENT FOR PAVEMENT SURFACE REPAIRS. VOLUME 2: SYNTHESIS OF OPERATIONAL DEFICIENCIES OF EQUIPMENT USED FOR PAVEMENT SURFACE REPAIRS Final Report
J. A. Crovetti, M. I. Darter, K. D. Johnson, K. L. Smith, and M. C. Belangie Feb. 1991 248 p Sponsored by Strategic Highway Research Program, Washington, DC
(PB92-135243; SHRP-M/UFR-91-505) Avail: NTIS HC/MF A11; also available in set of 3 reports HC/MF E99 CSCL 13B

Volume 2 of the three-volume set investigates the deficiencies of current maintenance equipment. Equipment used for common maintenance activities is thoroughly examined. Much of the information in the report was obtained through questionnaires sent to state agencies and contractors. The purpose of the report is to identify the limitations of existing maintenance equipment; subsequent research will then focus on defining desirable maintenance equipment characteristics. GRA

N92-22162# ERES Consultants, Inc., Savoy, IL.
INNOVATIVE MATERIALS AND EQUIPMENT FOR PAVEMENT SURFACE REPAIRS. VOLUME 3: DATA BASE USERS GUIDE
G. S. James Feb. 1991 98 p Sponsored by Strategic Highway Research Program, Washington, DC
(PB92-135250; SHRP-M/UFR-91-506) Avail: NTIS HC/MF A05; also available in set of 3 reports HC/MF E99 CSCL 13B

Volume 3 of this three-volume set is a user's manual that describes the use and manipulation of the Relational Database Manager (ORACLE) which was used in this project. The data base contains product information and performance histories of many patching and sealing materials, as well as performance information on various types of equipment for patching and sealing. The report also contains supplemental information on the development of the data base, as well as a copy of the questionnaire that was used in this research effort. GRA

N92-22235*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE ROLE OF FAILURE/PROBLEMS IN ENGINEERING: A COMMENTARY OF FAILURES EXPERIENCED - LESSONS LEARNED
R. S. Ryan Mar. 1992 142 p
(NASA-TP-3213; M-684; NAS 1.60:3213) Avail: NTIS HC/MF A07 CSCL 13B

The written version of a series of seminars given to several aerospace companies and three NASA centers are presented. The results are lessons learned through a study of the problems experienced in 35 years of engineering. The basic conclusion is that the primary cause of problems has not been mission technologies, as important as technology is, but the neglect of basic principles. Undergirding this is the lack of a systems focus from determining requirements through design, verification, and operations phases. Many of the concepts discussed are fundamental to total quality management (TQM) and can be used to augment this product enhanced philosophy. Fourteen principles are addressed with problems experienced and are used as examples. Included is a discussion of the implication of constraints, poorly defined requirements, and schedules. Design guidelines, lessons learned, and future tasks are listed. Two additional sections are included that deal with personal lessons learned and thoughts on future thrusts (TQM). Author

N92-22253# Lawrence Livermore National Lab., CA.
SHOCK COOLING OF LIQUID NITROGEN AND SUPERFLUID HELIUM
M. Ross Sep. 1991 18 p Presented at the 13th AIRAPT International Conference on High Pressure Science and Technology, Bangalore (India), 7-11 Oct. 1991
(Contract W-7405-eng-48)
(DE92-006887; UCRL-JC-108107; CONF-9110228-7) Avail: NTIS HC/MF A03

Superfluid Helium (II) and liquid nitrogen are the only liquids which have been shown experimentally to exhibit shock coolinf. In the present paper, we use the Landau model to demonstrate theoretically that the roton gap, which decreases with increasing density, plays the same role leading to shock cooling in liquid helium as the dissociation energy does in liquid nitrogen. DOE

N92-22293# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
5 Aug. 1991 50 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-91-017) Avail: NTIS HC/MF A03

A bibliography is given of science and technology research in China. Topics covered include aerospace technology, defense research and development, biotechnology, computers, lasers, sensors, optics, microelectronics, superconductivity, telecommunications, and particle accelerators. Author

N92-22296# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ENGINEERING AND EQUIPMENT
2 Jan. 1992 29 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-92-001) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in engineering and equipment. Topics covered include nuclear energy; non-nuclear energy; turbines; engines propulsion systems; the mechanics of gases, liquids, and solids; and industrial planning, technology, and productivity. Author

N92-22297# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ENGINEERING AND EQUIPMENT
29 Oct. 1991 16 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-91-011) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in engineering and equipment. Topics covered include aviation, space technology, optics, high energy devices, nuclear energy, and industrial technology, planning, and productivity. Author

N92-22298# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: ENGINEERING AND EQUIPMENT
31 Jan. 1992 33 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-92-002) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in engineering and equipment. Topics covered include aviation, space technology, optics, high energy devices, nuclear energy, electric power transmission lines, and industrial technology, planning, and productivity. Author

N92-22302# Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium). Dept. of Mechanical Engineering.
PRESS: A KNOWLEDGE BASED PROCESS PLANNER FOR SHEET METAL FABRICATION
Stephan Belaen and Steven Tilley Aug. 1991 68 p Sponsored by Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture
(CRIF-MC-92; ETN-92-91023) Avail: NTIS HC/MF A04

A project aimed at integrating the design and process planning for sheet metal is described. Form feature description is used for easy exchange of data between several automated systems. The reasoning is based on knowledge representation techniques. The rules contained in the system follow the actual human decision making rules and the physical or empirical laws describing the production processes. The final decisions and choices are made using strict economical criteria, i.e., minimum cost. The system developed fulfills to a large extent the goals defined for an integrated manufacturing system. Some practical problems remain however. The major problem in such a system is the interfacing of the design and planning modules. The description of the part model is further complicated by the use of three-dimensional data. Therefore, the operations (typically deformation techniques such as bending) that manipulate these data need some additional research, which could not be included in the current project. Secondly, no link is currently available to integrate the computer aided manufacturing. ESA

N92-22397# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ENGINEERING AND EQUIPMENT
6 Sep. 1991 26 p Transl. into ENGLISH of various Russian articles
(JPRS-UEQ-91-010) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in engineering and equipment. Topics covered include optics; high energy devices; nuclear and non-nuclear energy; the mechanics of gases, liquids, and solids; and industrial technology, planning, and productivity. Author

N92-22591# Oxford Univ. (England). Robotics Research Group.
ROBOT FORCE CONTROL FOR HAZARDOUS DRILLING OPERATIONS
Gursel Alici (Gaziantep Univ., Turkey) and R. W. Daniel 1991 63 p
(OUEL-1898/91; ETN-92-91089) Avail: NTIS HC/MF A04

The use of robot manipulators for tasks which are inherently risky for human beings, specifically hazardous drilling operations, is investigated. Although drilling is one of the simplest and most basic metal cutting processes, robot drilling is problematic and has resulted in extreme operator fatigue and shorter drill life under telemanipulator control due to a number of possible causes such as dynamic and static effects. Both originate from differences between a robot and a drilling machine. A detailed study of the task highlighted the fact that it is necessary to regulate the distance dependent force by closed loop force control. How the robot type force could be controlled together with the robot position to allow fast drilling but without too much drill wear was considered. The answer was found in further exploration of the tasks which generated a set of specifications and problems that were addressed using novel strategies rather than those usually adopted for robots. The possible solutions are given in terms of a new control strategy and the correct choice of coordinate system to be used within that strategy. ESA

N92-22425*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
APPLYING NASA'S EXPLOSIVE SEAM WELDING
Laurence J. Bement *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 10-23 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 13H

N92-22720*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
THERMOACOUSTIC REFRIGERATION
Steven L. Garrett and Thomas J. Hofler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 397-406 Sponsored in part by ONR and Office of Naval Technology (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13B

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-22107# Matis, Inc., Decatur, GA.
DEVELOPMENT OF THE THEORY AND ALGORITHMS FOR SYNTHESIS OF REFLECTOR ANTENNA SYSTEMS Final Report, 1 Oct. 1990 - 30 Sep. 1991
Vladimir Oliker 28 Nov. 1991 43 p
(Contract F49620-91-C-0001)
(AD-A244775; RASO1F; AFOSR-91-1014TR) Avail: NTIS HC/MF A03 CSCL 09/1

The main objective of this work is research and development of the theory and constructive computational algorithms for synthesis of single and dual reflector antenna systems in geometric optics approximation. During the reporting period, the direct and inverse problems of design of reflector antennas were investigated. In case of single reflector antennas, explicit conditions for solvability of the partial differential equation describing the system were established. An algorithm, based on a special diffusion process, for solving the equation numerically was developed and tested. Differential geometric methods were applied successfully to describe and investigate the single and dual reflector antenna systems. GRA

N92-22147*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
ELECTROMAGNETIC CHARACTERIZATION OF CONFORMAL ANTENNAS
John L. Volakis, Leo C. Kempel, Angelos Alexanian, J. M. Jin, C. L. Yu, and Alex C. Woo (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) 15 Jan. 1992 56 p
(Contract NCA2-543)
(NASA-CR-189530; NAS 1.26:189530; UMICH-027723-4-T)
Avail: NTIS HC/MF A04 CSCL 20N

The ultimate objective of this project is to develop a new technique which permits an accurate simulation of microstrip patch antennas or arrays with various feed, superstrate and/or substrate configurations residing in a recessed cavity whose aperture is planar, cylindrical or otherwise conformed to the substructure. The technique combines the finite element and boundary integral methods to formulate a system suitable for solution via the conjugate gradient method in conjunction with the fast Fourier transform. The final code is intended to compute both scattering and radiation patterns of the structure with an affordable memory demand. With upgraded capabilities, the four included papers examined the radar cross section (RCS), input impedance, gain, and resonant frequency of several rectangular configurations using different loading and substrate/superstrate configurations. For individual titles, see N92-22148 through N92-22151.

N92-22148*# Michigan Univ., Ann Arbor.
RCS REDUCTION OF A MICROSTRIP PATCH USING LUMPED LOADS
John L. Volakis and Angelos Alexanian *In its* Electromagnetic Characterization of Conformal Antennas 15 Jan. 1992 18 p
(For primary document see N92-22147 13-32)
Avail: NTIS HC/MF A04 CSCL 20N

In this report we consider the radar cross section (RCS) of a single rectangular patch antenna in a recessed cavity. Using a previously developed finite element-boundary integral method code, a study is performed on the patch's RCS as a function of frequency. To reduce the RCS of the patch at the resonant frequency, lumped (resistive) loads are placed at the edges of the patch. The effects of the lumped loads on the patch's RCS and gain are examined and it is observed that the RCS and gain are reduced as the as the load value decreases, whereas the antenna's bandwidth is increased. At resonance, the usual relations between the RCS and gain is observed, but it is shown that this relation no longer holds at frequencies away from resonance. Author

N92-22149*# Michigan Univ., Ann Arbor.
A SCHEME TO ALTER THE RESONANT FREQUENCY OF THE MICROSTRIP PATCH ANTENNA
John L. Volakis and J. M. Jin *In its* Electromagnetic Characterization of Conformal Antennas 15 Jan. 1992 9 p
(For primary document see N92-22147 13-32)
Avail: NTIS HC/MF A04 CSCL 20N

Simple schemes are presented for altering the resonant frequency of a rectangular patch antenna without the need to change its size. In particular, by placing a perturbance below the patch it is shown that as much as 20 percent increase and 30 percent decrease from the resonant frequency of the unperturbed patch can be achieved. The specific configurations considered in this letter include a cavity-backed, aperture-backed, and protrusion-backed patch, and for each case design curves are presented. Author

N92-22150*# Michigan Univ., Ann Arbor. Radiation Lab.
A COLLECTION OF EDGE-BASED ELEMENTS
Leo C. Kempel and John L. Volakis *In its* Electromagnetic Characterization of Conformal Antennas 15 Jan. 1992 15 p
(For primary document see N92-22147 13-32)
Avail: NTIS HC/MF A04 CSCL 20N

Edge-based elements have proved useful in solving electromagnetic problems since they are nondivergent. Previous authors have presented several two and three dimensional elements. Herein, we present four types of elements which are suitable for modeling several types of three dimensional geometries. Distorted brick and triangular prism elements are given in cartesian coordinates as well as the specialized cylindrical shell and pie-shaped prism elements which are suitable for problems best described in polar cylindrical coordinates. Author

N92-22151*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MODELING OF RESISTIVE SHEETS IN FINITE ELEMENT SOLUTIONS
J. M. Jin, John L. Volakis, C. L. Yu (Pacific Missile Test Center, Point Mugu, CA.), and Alex C. Woo *In* Michigan Univ., Electromagnetic Characterization of Conformal Antennas 15 Jan. 1992 11 p Previously announced as N92-18922 (For primary document see N92-22147 13-32)
Avail: NTIS HC/MF A04 CSCL 20N

A formulation is presented for modeling a resistive card in the context of the finite element method. The appropriate variational function is derived and for variational purposes results are presented for the scattering by a metal-backed cavity loaded with a resistive card. Author

N92-22166# Tromsoe Satellite Station (Norway).
HILAT/POLAR BEAR AND POLAR BEACON SATELLITE PROGRAM AT TROMSO, NORWAY Final Report, 15 Dec. 1989 - 14 Dec. 1990
Einar Ellingsen 20 Sep. 1991 13 p
(Grant AF-AFOSR-0115-90)
(AD-A244964; TSS-01-91; PL-TR-91-2243) Avail: NTIS HC/MF A03 CSCL 20/14

Communication systems of different kinds suffer degradation in performance due to phase and intensity scintillations imposed by the ionospheric irregularities of electron density. In an effort to study plasma structuring, the Hilat and Polar Bear Satellites were launched in 1983 and 1986. Tromso Satellite Station is located within the nighttime auroral oval. Beacon and telemetered in-situ data from both satellites were recorded. Raw beacon data as well as the telemetered in-situ data and on-line processed scintillation statistics are recorded on raw and summary tapes. GRA

N92-22172# Mitre Corp., Bedford, MA.
RADIATION EFFICIENCY AND INPUT IMPEDANCE OF MONOPOLE ELEMENTS WITH RADIAL-WIRE GROUND PLANES IN PROXIMITY TO EARTH
M. M. Weiner and S. Zamoscianyk Sep. 1991 53 p
(AD-A244578; M91-104) Avail: NTIS HC/MF A04 CSCL 20/3

Plots are presented, of the radiation efficiency and input impedance of a thin quarter-wave monopole element with a radial wire ground plane in proximity to flat lossy earth, as a function of the number and length of the radial wires, earth permittivity, and location of the earth's surface with respect to the ground plane. The method of moments models have certain advantages over models based on Monteath's compensation theorem or Sommerfeld's attenuation function. These advantages are as follows: current on the ground plane is determined rather than approximated by that for a perfect ground plane; results are valid not only for moderately-large ground planes but for electrically-small ground planes; directive gain and radiation efficiency can each be determined separately rather than being lumped together as a product to yield the antenna power gain; ground plane edge diffraction is not neglected; and analytical conditions on evaluating Sommerfeld's integral are avoided. GRA

N92-22189*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering and Computer Science.
DEVELOPMENT OF 3D ELECTROMAGNETIC MODELING TOOLS FOR AIRBORNE VEHICLES Semiannual Progress Report, Sep. 1991 - Feb. 1992
John L. Volakis Feb. 1992 54 p
(Grant NAG2-541)
(NASA-CR-189952; NAS 1.26:189952; UMICH-025921-28-T)
Avail: NTIS HC/MF A04 CSCL 20N

The main goal of this report is to advance the development of methodologies for scattering by airborne composite vehicles. Although the primary focus continues to be the development of a general purpose computer code for analyzing the entire structure as a single unit, a number of other tasks are also being pursued in parallel with this effort. One of these tasks discussed within is on new finite element formulations and mesh termination schemes. The goal here is to decrease computation time while retaining accuracy and geometric adaptability.The second task focuses on the application of wavelets to electromagnetics. Wavelet transformations are shown to be able to reduce a full matrix to a band matrix, thereby reducing the solutions memory requirements. Included within this document are two separate papers on finite element formulations and wavelets. For individual titles, see N92-22190 through N92-22191.

N92-22190*# Michigan Univ., Ann Arbor.
A FINITE ELEMENT FORMULATION FOR SCATTERING FROM ELECTRICALLY LARGE 2-DIMENSIONAL STRUCTURES
Daniel C. Ross and John L. Volakis *In its* Development of 3D Electromagnetic Modeling Tools for Airborne Vehicles Feb. 1992 p 1-11 (For primary document see N92-22189 13-32)
Avail: NTIS HC/MF A04 CSCL 20N

A finite element formulation is given using the scattered field approach with a fictitious material absorber to truncate the mesh. The formulation includes the use of arbitrary approximation functions so that more accurate results can be achieved without any modification to the software. Additionally, non-polynomial approximation functions can be used, including complex approximation functions. The banded system that results is solved with an efficient sparse/banded iterative scheme and as a consequence, large structures can be analyzed. Results are given for simple cases to verify the formulation and also for large, complex geometries. Author

N92-22191*# Michigan Univ., Ann Arbor. Radiation Lab.
WAVELETS AND ELECTROMAGNETICS
Leo C. Kempel *In its* Development of 3D Electromagnetic Modeling Tools for Airborne Vehicles Feb. 1992 27 p (For primary document see N92-22189 13-32)
Avail: NTIS HC/MF A04 CSCL 20N

Wavelets are an exciting new topic in applied mathematics and signal processing. This paper will provide a brief review of wavelets which are also known as families of functions with an emphasis on interpretation rather than rigor. We will derive an indirect use of wavelets for the solution of integral equations based techniques adapted from image processing. Examples for resistive strips will be given illustrating the effect of these techniques as well as their promise in reducing dramatically the requirement in order to solve an integral equation for large bodies. We also will present a direct implementation of wavelets to solve an integral equation. Both methods suggest future research topics and may hold promise for a variety of uses in computational electromagnetics. Author

N92-22410# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
NOTE ON THE DERIVATION OF THE HUYGENS PRINCIPLE FOR THE BIANISOTROPIC MEDIUM
I. V. Lindell Feb. 1991 11 p
(PB92-142009; ISBN-951-22-0551-3; Rept-86) Avail: NTIS HC/MF A03 CSCL 20N

The Huygens principle, i.e., replacing sources and boundaries behind a surface by equivalent surface sources, is extremely applicable in many branches of electromagnetic analysis, for example, in computing radiation from aperture antennas. Its derivation in textbooks is, however, normally presented in a quite complicated manner involving Green dyadics and Green formulas, which give the wrong idea that the principle is dependent on the medium. The objective of the present note is to present a derivation which is both simple and applicable to any linear media - isotropic, anisotropic, chiral or bianisotropic, homogeneous or inhomogeneous - without resort to Green functions. GRA

N92-22412# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
BI-ISOTROPIC CONSTITUTIVE RELATIONS
A. H. Sihvola and I. V. Lindell Mar. 1991 12 p
(PB92-142017; ISBN-951-022-0554-8; Rept-87) Avail: NTIS HC/MF A03 CSCL 20N

The constitutive relations of general bi-isotropic media, requiring four material parameters, can be written in different ways to describe their electromagnetic behavior. This communication contains a two-way 'dictionary' between a proposed formulation of the constitutive relations with three other sets of relations, generalized from relations used for chiral materials. GRA

N92-22484*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
USER'S MANUAL FOR THREE DIMENSIONAL FDTD VERSION B CODE FOR SCATTERING FROM FREQUENCY-DEPENDENT DIELECTRIC MATERIALS
John H. Beggs, Raymond J. Luebbers, and Karl S. Kunz Jan. 1992 31 p
(Grant NAG1-1221)
(NASA-CR-190108; NAS 1.26:190108) Avail: NTIS HC/MF A03 CSCL 20N

The Penn State Finite Difference Time Domain Electromagnetic Code Version B is a three dimensional numerical electromagnetic scattering code based upon the Finite Difference Time Domain Technique (FDTD). The supplied version of the code is one version of our current three dimensional FDTD code set. This manual provides a description of the code and corresponding results for several scattering problems. The manual is organized into 14 sections: introduction, description of the FDTD method, operation, resource requirements, Version B code capabilities, a brief description of the default scattering geometry, a brief description of each subroutine, a description of the include file, a discussion of radar cross section computations, a discussion of some scattering results, a sample problem setup section, a new problem checklist, references and figure titles. Author

N92-22501*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
FINITE DIFFERENCE TIME DOMAIN CALCULATION OF TRANSIENTS IN ANTENNAS WITH NONLINEAR LOADS
Raymond J. Luebbers, John H. Beggs, Karl S. Kunz, and Kent Chamberlin (New Hampshire Univ., Durham.) Jul. 1991 16 p (Grant NAG1-1221)
(NASA-CR-190101; NAS 1.26:190101) Avail: NTIS HC/MF A03 CSCL 20N

Determining transient electromagnetic fields in antennas with nonlinear loads is a challenging problem. Typical methods used involve calculating frequency domain parameters at a large number of different frequencies, then applying Fourier transform methods plus nonlinear equation solution techniques. If the antenna is simple enough so that the open circuit time domain voltage can be determined independently of the effects of the nonlinear load on the antennas current, time stepping methods can be applied in a straightforward way. Here, transient fields for antennas with more general geometries are calculated directly using Finite Difference Time Domain (FDTD) methods. In each FDTD cell which contains a nonlinear load, a nonlinear equation is solved at each time step. As a test case, the transient current in a long dipole antenna with a nonlinear load excited by a pulsed plane wave is computed using this approach. The results agree well with both calculated and measured results previously published. The approach given here extends the applicability of the FDTD method to problems involving scattering from targets, including nonlinear loads and materials, and to coupling between antennas containing nonlinear loads. It may also be extended to propagation through nonlinear materials. Author

N92-22545# Telesat Canada, Ottawa (Ontario).
THE FUTURE IS NOW!
Richard Jestin, comp., Patricia Kube, comp., Colleen Lambert, comp., and Sree Tiwari, comp. 1989 511 p Canadian Satellite User Conference 1989 held in Ottawa, Ontario, 19-21 Jun. 1989
(ISBN-0-9692920-1-5; CTN-92-60395) Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The purpose of this conference was to provide a forum for the exchange of information, experience, and ideas among service users and professionals working in the satellite communications industry in Canada. Presentations covered a wide range of satellite technologies, applications, and issues of common concern to the communications community. Technology sessions included very small aperture terminal (VSAT) technology and applications, digital transmission networks, and the Anik E and MSAT satellites. Applications areas covered included broadcast services, video conferencing services, government and military satellite applications, communications services to remote and northern locations, educational communications systems, health information communications systems, and business services. Issues and policy matters included papers on policy development, risk management, communications spectrum management, and international cooperation. For individual titles, see N92-22546 through N92-22589.

N92-22546# Alberta Public Works Supply and Services, Edmonton.
ALBERTA GOVERNMENT TRIAL OF VSAT TECHNOLOGY
A. Rodney Allan and Goodwin K. Young (Microtel Pacific Research Ltd., Burnaby, British Columbia) *In* Telesat Canada, The Future is Now! 1989 p 3-7 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Very small aperture terminal (VSAT) satellite systems offer the capability to quickly establish a data communications network without the necessity of installing terrestrial lines. Current VSAT systems also allow local management of the network, have excellent error rate performance, and can simultaneously support several different communications protocols. This paper describes the Government of Alberta's field trial of VSAT technology undertaken to investigate (1) the use of band-edge capacity of the Ku-band television channel transmitted over the Anik C3 satellite to transmit text and data, (2) the data protocol handling capabilities of the system, and (3) the application of VSAT technology to education and oil industry communications requirements. The system consists of a hub which handles transmission to and from the satellite, and multiple remote VSAT terminals in a star network. As a result of this trial, it was recommended that the VSAT system be configured to permit minor configuration changes online, to allow parallel downloading of common protocol software components, to allow configuration changes to be prepared and verified in advance of downloading remote terminals, that nonvolatile read/write memory capabilities be added to the remote terminals, and that remote diagnostics capabilities for VSAT be implemented. Finally, it was recommended that usage statistics be reported and a high speed X.25 computer interface capability be provided. Author (CISTI)

N92-22547# John Bell Technical Systems Ltd., Hampshire (England).
VSAT INTERACTIVE DATA NETWORKS: DEVELOPING A PRACTICAL EXAMPLE
Jeremy Moss *In* Telesat Canada, The Future is Now! 1989 p 17-20 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Many problems have been encountered in the design of reliable interactive very small aperture terminal (VSAT) networks. This paper presents the development of a practical system, based on standard hardware components, which is now in operation in northern Canada. The system allows Computalog, an oil well data logging organization, to retrieve large amounts of data rapidly from very remote locations. The Star configured network gives timesliced point to point data transfer at up to 224 kbits/s over a single dedicated forward and return channel. The system operates under harsh conditions with high reliability and security. Backup channels are provided over earth-based communications systems in case of total system failure. The system is used in northern locations close to the limit of the satellite footprint and where weather conditions may add to system degradation. Major implementation problems were avoided by using good design, testing and management practices. However, difficulties arose in the integration of the communications sub-system within the data logging computer. The paper sets out the system design in more detail, outlining how this low-cost system was successfully implemented with a minimum number of problems. Author (CISTI)

N92-22548# Telesat Canada, Ottawa (Ontario).
PERFORMANCE ANALYSIS OF A VSAT NETWORK
Fouad G. Karam, Neville Miller, and Antoine Karam *In its* The Future is Now! 1989 p 21-26 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

With the growing need for efficient satellite networking facilities, the very small aperture terminal (VSAT) technology emerges as the leading edge of satellite communications. Achieving the required performance of a VSAT network is dictated by the multiple access technique utilized. Determining the inbound access method best suited for a particular application involves trade-offs between response time and space segment utilization. In this paper, the slotted Aloha and dedicated stream access techniques are compared. It is shown that network performance is dependent on the traffic offered from remote earth stations as well as the sensitivity of customer's applications to satellite delay.
Author (CISTI)

N92-22549# CNCP Telecommunications, Toronto (Ontario).
WHEN AND WHY VSAT
Dan Hector *In* Telesat Canada, The Future is Now! 1989 p 27-31 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

An analysis is provided of (1) the capital costs for establishing

a satellite very small aperture terminal (VSAT) two-way interactive data communications network, and (2) the space segment and non-space segment operating costs which are likely to be incurred by system users. VSAT services minimize capital investment requirements. They can economically compete with terrestrial alternatives in locations away from major telecommunication centers or between widely separated points. The further the distance between sites and the higher the remote site capacity the more economic is the VSAT alternative. VSAT networks are well suited to thin route transaction based interactive inquiry response applications and are not designed to compete with heavy route terrestrial alternatives. Most users will combine satellite and terrestrial networks to optimize cost and performance. These hybrid networks must be carefully designed and integrated to allow the economic benefits to be realized. Author (CISTI)

N92-22550# Communications Engineering Services Ltd., Etobicoke (Ontario).
EARTH STATION SITE ENGINEERING IN A TERRESTRIAL INTERFERENCE ENVIRONMENT
Ralph vonEppinghoven *In* Telesat Canada, The Future is Now! 1989 p 47-51 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Reception of C-band satellite television signals is now widespread throughout Canada. One problem that many satellite users still face is signal degradation due to terrestrial interference. The desired satellite signal is deteriorated due to the simultaneous reception of an unwanted microwave signal originating from land based (terrestrial) common carrier transmission networks. Careful antenna site engineering can reduce interfering carrier levels to allow unimpaired reception of desired satellite signals. If a proposed television receive only (TVRO) site is suspected of having terrestrial interference, then a detailed interference survey of the site must be performed to determine the suitability of the site. If site testing indicates that significant levels of interference are present, it may still be possible to operate the site without received signal degradation. Extraordinary measures such as site excavation, antenna shielding, signal filtering and antenna optimization must be implemented to achieve unimpaired signal reception.
Author (CISTI)

N92-22551# Asia Satellite Telecommunications Co. Ltd. (Hong Kong).
A SATELLITE FOR ASIA
John D. R. Lawrence *In* Telesat Canada, The Future is Now! 1989 p 55-59 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

In April 1990, an American satellite will be launched by China on the Long March 3 rocket. This satellite, called AsiaSat 1 will provide domestic telecommunications service to the countries of Asia. AsiaSat 1 is designed to provide satellite communications services to China, Thailand and Pakistan. These services will also be available for the use of neighboring countries such as Korea, Hong Kong, Burma and Nepal. As an independently financed satellite, it will provide services to each of these countries on an equal access basis and will be shared by these countries depending on their needs. The satellite's 24 C-band transponders will be leased or sold to customers in each of these countries. Transponders will be used for many purposes including back-up to national telephone networks, new private network services and the distribution of television programs. Author (CISTI)

N92-22552# SkyWave Electronics Ltd., Kanata (Ontario).
SUBSCRIBER TERMINALS USING AMPLITUDE COMPANDED SINGLE SIDEBAND (ACSSB)
Bob Lyons and Andrew Forrest *In* Telesat Canada, The Future is Now! 1989 p 63-68 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

With the introduction of amplitude companded single sideband (ACSSB) modulation, and other innovations, small subscriber satellite terminals providing voice and up to 2400 bit per second (bps) data capability have been produced. These terminals address a class of applications that requires: access to the public switched telephone network (PSTN); reliable voice and data communication; modest capital and operating costs; ease of installation and operation; and in some cases, portability. This paper discusses applications, design goals and characteristics of subscriber terminals, concluding with two representative network scenarios. Applications of these terminals differ from those best served by very small aperture terminals (VSATs) by offering low startup costs and by servicing primarily voice traffic. Fold-up antennas and compact reliable radio frequency (RF) electronics have made highly portable terminals a reality also. Private networks are possible using simple circuit sharing techniques while larger networks can utilize circuit switching to achieve significant economies in operating costs. Recent regulatory changes have paved the way for increased activity and development in these markets. Author (CISTI)

N92-22553# Infosat Telecommunications Ltd., Burnaby (British Columbia).
TRANSPORTABLE SATELLITE VOICE TERMINALS IN CANADA'S NORTH: BENEFITS FROM THE USERS' PERSPECTIVES
Christopher B. Sivertz *In* Telesat Canada, The Future is Now! 1989 p 69-76 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Infosat Telecommunications has developed a series of Ku-band transportable terminals for toll-quality telecommunications applications. These terminals are designed to provide reliable telephone, Group III facsimile, and computer data to users needing communications on short notice. The terminals are capable of providing full duplex service interconnecting into the public switched network or operating as an off-premise extension of an office private branch exchange. The terminals use a 1.8 m antenna and can be deployed from the back of a pick-up truck, single axle trailer or surface-mounted metal base. They operate reliable in extreme conditions and are very satellite efficient. This paper describes the features and performance of these terminals. Highlights of a number of remote installations are also discussed.
Author (CISTI)

N92-22554# International Datacasting Corp., Ottawa (Ontario).
INTERNATIONAL DATACASTING'S AQUARIUS AND I/LINK NETWORKS
Susan M. Noppe *In* Telesat Canada, The Future is Now! 1989 p 77-80 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Many communications applications are surfacing which cannot be implemented on traditional equipment. Many corporations are demanding private, dedicated inter-branch data networks while others require high speed data links to remote locations. This paper presents two International Datacasting Corporation networks designed to provide such capabilities: Aquarius and I/LINK. Aquarius is a high speed point to multi-point satellite network which provides an interface compatible with the X.25 equipment used by most North American companies. I/LINK is a satellite network designed to connect private corporate networks of primary access integrated, switched data network (ISDN) services. Each island would contain equipment such as telephones, PC LANs, document image processing systems, FAX, electronic mail, and audio/video conferencing facilities. I/LINK will connect earthbound, primary access ISDN systems with a satellite transmission service. The I/LINK design eliminates the double hop delay factor in voice transmission. I/LINK stations will communicate with each other via a Ku-band geosynchronous satellite. It will permit use of very small aperture terminal satellite communications stations employing small (1.8 to 2.4 m) antennas. Author (CISTI)

N92-22555# Cylink, Sunnyvale, CA.
ADVANCED TECHNOLOGIES FOR ENCRYPTION OF SATELLITE LINKS
Sherry S. McMahan *In* Telesat Canada, The Future is Now! 1989 p 81-85 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The use of encryption on satellite links is discussed. Advanced technology exists to provide transmission security for large earth station with data rates up to 50 megabits per second. One of the major concerns in the use of encryption equipment with very small aperture terminals (VSAT) is the key management issue and the related operational costs. The low cost requirement and the lack of physical protection of remote VSATs place severe constraints on the design of encryption equipment. Encryption may be accomplished by embedding a tamper proof encryption module into the baseband unit of each VSAT. VSAT networks are usually star networks where there is a single large earth station that serves as a hub and all satellite communications takes place between each VSAT and the hub earth station. The hub earth station has the secret master key of each VSAT. These master keys are used to downline load encrypted session keys to each VSAT. A more secure alternative is to use public key techniques where each embedded VSAT encryption module internally generates its own secret and public numbers. The secret number never leaves the module while the public number is sent to the hub at the time of initialization of the encryption module into the VSAT. Physical access control to encryption modules of VSAT systems can be implemented using passwords, smart cards or biometrics. Author (CISTI)

N92-22556# Microtel Pacific Research Ltd., Burnaby (British Columbia).
USING A SINGLE CHIP FEC FOR SATELLITE SYSTEMS
L. Onotera and R. Nicholson *In* Telesat Canada, The Future is Now! 1989 p 86-89 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Information transmission over digital satellite communication channels is primarily power-limited, where forward error correction (FEC) codes can significantly improve performance. The use of FEC can reduce the required signal to noise ratio to sustain a given bit error rate. The use of forward error correction has become a standard part of present day digital satellite communication systems. Means of applying a new very large scale integration (VLSI) integrated circuit FEC chip into various kinds of systems is discussed. Specifically, some of the considerations and tradeoffs in continuous single channel per carrier (SCPC), multiple channels per carrier (MCPC), and burst systems are related to the new design. This new chip will provide an effective space and cost advantage by inserting a powerful forward error correction capability into most types of satellite digital communication links.
Author (CISTI)

N92-22557# Norsat International, Inc., Surrey (British Columbia).
MICROSAT PERSONAL EARTH STATIONS: BRINGING SATELLITE COMMUNICATIONS CLOSER TO THE USER
John Q. Pinkney *In* Telesat Canada, The Future is Now! 1989 p 90-94 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The trend in systems development in point to multipoint satellite communications systems has been a continuing reduction in antenna size from high-power centralized earth stations to smaller terminals with antennas less than 2 meters in diameter serving a single site. Current satellite and computer technology makes it possible to design receive terminals which use antennas 0.75 meters in diameter or less and are inexpensive enough to be afforded by private individuals. These Personal Earth Stations (PES) receive data from the satellite at nominal baud rates (32 kilobaud or less) and feed the data directly into the user's personal computer. All the tuning, addressing and data transfer functions for the system could be controlled directly by the user's PC. The cost advantages (in both the space segment and receive hardware) for PES's open up many potential applications such as satellite bulletin boards, remote network sensing and maintenance, and inexpensive portable receive terminals. If periodic feedback is required from terminals, the system might be configured to use the high rate satellite broadcast system to send information from the hub to remote stations but use low rate telephone communications for response transmittal. Depending on the size and traffic required for such a network, a varied amount of savings can be realized over existing alternate systems. Author (CISTI)

N92-22558# Telesat Canada, Ottawa (Ontario).
AN OVERVIEW OF THE TECHNICAL DESIGN OF MSAT MOBILE SATELLITE COMMUNICATIONS SERVICES
N. George Davies *In its* The Future is Now! 1989 p 97-101 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The Canadian MSAT mobile satellite communications system is being implemented in cooperation with the American Mobile Satellite Consortium (AMSC). Two satellites are to be jointly acquired and each satellite is expected to backup the other. This paper describes the technical concepts of the services to be offered and the baseline planning of the infrastructure for the ground segment. MSAT service requirements are analyzed for mobile radio, telephone, data, and aeronautical services. The MSAT system will use nine beams in a narrow range of L-band frequencies with frequency reuse. Beams may be added to cover flight information areas in the Atlantic and Pacific oceans. The elements of the network architecture are: a network control centre, data hub stations, gateway stations, base stations, mobile terminals, and a signalling system to interconnect the elements of the system. The network control center will manage the network and allocate space segment capacity; data hub stations will support a switched packet mobile data service; the gateway stations will provide interconnection to the public telephone system and data networks; and the base stations will support private circuit switched voice and data services. Several alternative designs for the signalling system are described. Author (CISTI)

N92-22559# Department of Communications, Ottawa (Ontario). Mobile Satellite Program Office.
A FIELD DEMONSTRATION PLAN FOR THE MSAT PROGRAM
D. Hugh M. Reekie and Jean-Guy Dumoulin (Communications Research Centre, Ottawa, Ontario) *In* Telesat Canada, The Future is Now! 1989 p 102-105 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

After many years of development, a range of mobile satellite communications equipment has become available. Voice terminals, both transportable and mobile are in use and are being field tested in specific remote environments; they are now available in sufficient quantities for field demonstrations and trials. Specific equipment for data terminal trials is also presently being field tested. This equipment, which presently operates via an available space segment, is the forerunner of the MSAT family of equipment which will be available when the MSAT spacecraft is launched. This paper describes the planning and user interfaces of a series of early communications trials across Canada. The specific hardware for the trials is described. A lightweight transportable unit with built-in signalling systems has been designed for a wide range of applications. A data communications systems, using store and forward and sophisticated forward error correction techniques will be used for some of the trials. Author (CISTI)

N92-22560# SkyWave Electronics Ltd., Kanata (Ontario).
DEVELOPMENT AND FIELD TRIAL OF A BRIEFCASE MOBILE SATELLITE VOICE/DATA TERMINAL
P. Rossiter, G. Knights, and M. Gelinas (Teleglobe Canada, Montreal, Quebec) *In* Telesat Canada, The Future is Now!

1989 p 106-110 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

During 1988, SkyWave and CBS developed and field-trialed a prototype battery-powered briefcase mobile satellite terminal for use with Inmarsat's Marecs B2 Atlantic Operating Region Satellite. The L-band terminal incorporated state of the art technology in the areas of modulation, coding, antenna design and communications protocol. Digital signal processing (DSP) was used extensively to implement modems and rate (R) 1/2 forward error correction (FEC) coding. The terminal, including batteries and antennas weighs 40 lbs, meets airline requirements for carry-on passenger luggage and is deployable within two minutes. Operation for over an hour is possible using internal batteries. This paper describes the terminal design and performance in field trials carried out by SkyWave, the Department of Communications, Teleglobe, Comsat and CBS, both in Canada and the USA, using Inmarsat satellite facilities. The system provides for one half duplex voice communication using linear predictive coding (LPC), differential minimum shift keying (DMSK), or amplitude companded single sideband (ACSSB) modulation and half duplex DMSK data transmission at 2400 bytes per second, R 1/2 forward error coding (FEC), or packet control. In general, users preferred the ACSSB to LPC for voice communication because of its more natural sound. Error free transmission of large text files between two personal computers was confirmed. Author (CISTI)

N92-22561# Gandalf Systems Group, Nepean (Ontario).
SOFTWARE AND MESSAGING FOR A MOBILE DATA SERVICE PROJECT
Brian K. Penney and John Seymour *In* Telesat Canada, The Future is Now! 1989 p 111-115 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

A trial of satellite based mobile data service (MDS) communications in the North American trucking industry is proposed for the first quarter of 1990. This paper describes the network configuration, the system software, communications protocols, and the user interfaces. The MDS will consist of 3,000 mobile earth terminals linked via C and L-band Marecs B2 satellite communications to a single hub earth station which will use a terrestrial X.25 network to connect 25 remote customer dispatch centers. The communications system is based on a modification of Inmarsat Standard C communications, coding and formats. The major differences are that the hub will serve the dual purpose of network control station and coastal earth station, and a three frame multislot protocol was adopted to permit a workable access format for the short and frequent messaging activity typical of the land mobile environment. Author (CISTI)

N92-22562# Communications Research Centre, Ottawa (Ontario).
A TMS320-BASED MODEM FOR THE AERONAUTICAL-SATELLITE CORE DATA SERVICE
Michael L. Moher and John H. Lodge *In* Telesat Canada, The Future is Now! 1989 p 116-120 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The International Civil Aviation Organization (ICAO) Future Air Navigation Systems (FANS) committee, the Airlines Electronics Engineering Committee (AEEC), and Inmarsat have been developing standards for an aeronautical satellite communications service. These standards encompass a satellite communications system architecture to provide comprehensive aeronautical communications services. Incorporated into the architecture is a core service capability, providing only low rate data communications, which all service providers and all aircraft earth terminals are required to support. In this paper an implementation of the physical layer of this standard for the low data rate core service is described. This is a completely digital modem (up to a low intermediate frequency). The implementation uses a single TMS320C25 chip for the transmit baseband functions of scrambling, encoding, interleaving, block formatting and modulation. The receiver baseband unit uses a dual processor configuration to implement the functions of demodulation, synchronization, de-interleaving, decoding and de-scrambling. The hardware requirements, the software structure and the algorithms of this implementation are described. Author (CISTI)

N92-22563# Department of Communications, Ottawa (Ontario).
THE INTERNATIONAL NEGOTIATION OF A NEW SATELLITE REGIME, 1987-1988
E. D. DuCharme *In* Telesat Canada, The Future is Now! 1989 p 123-125 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

During the latter part of 1987 and 1988, a series of congresses and meetings were held which lead to a new regime for communications satellites. This regime will dictate the international regulatory environment for the next 10 to 20 years. A trilateral arrangement between the USA, Mexico, and Canada was reached in May 1988 defining the shared use of the geostationary satellite orbit and those Ku and C frequency bands currently used by the Anik satellite. In the fall of 1988, the International Telecommunication Union (ITU) convened a World Administrative Radio Conference (WARC) for the space services and revised all of the international regulations governing the coordination and operation of the fixed satellite service. In addition, an orbit and frequency allotment plan was established which reserves part (800 MHz) of the C and Ku frequency bands allocated to the fixed satellite service and an orbit location for each member country of the ITU. In the fall of 1987 the ITU convened a WARC for mobile services which made additional provisions for the mobile satellite service in the International Table of Frequency Allocations. This paper describes the processes involved in these various events. Author (CISTI)

N92-22564# Department of Communications, Ottawa (Ontario).
THE ORBIT-SHARING ENVIRONMENT FOR CANADIAN FIXED SATELLITES IN THE 1990S AND BEYOND
Robert R. Bowen and Irena Streibl *In* Telesat Canada, The Future is Now! 1989 p 126-131 (For primary document see N92-22545 13-32)
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In 1987, it was recognized that the portion of the geostationary orbit of interest to Canada for its domestic satellites was becoming saturated. At the same time there was a need to accommodate the Anik E series of dual band communication satellites which was not possible under existing orbit-use arrangements. A trilateral arrangement between the USA, Mexico, and Canada was reached in May 1988 defining the shared use of the geostationary satellite orbit and those Ku and C frequency bands currently used by the Anik satellite. The World Administrative Radio Conference (WARC) for the space services held in May, 1988 developed an allotment plan for the upper 6/4 GHz band and the 13/11 GHz band. The Anik series of satellites will face a reduction of the 5 deg spacing of the 1970s to about 3 deg for the Anik E series, with satellites at 3.8 deg spacing interleaved with Mexican MORELOS satellites. Four such positions are available for the Anik E series. Three colocated orbit positions in the 13/11 and upper 6/4 GHz allotment plan are reserved for future Canadian use. In addition, more bandwidth is available. Author (CISTI)

N92-22565# Department of Communications, Ottawa (Ontario). Space Spectrum Engineering.
TECHNICAL BASIS OF THE ITU ALLOTMENT PLAN FOR THE FIXED SATELLITE SERVICE IN THE EXPANSION BANDS
V. Sahay and V. Rawat *In* Telesat Canada, The Future is Now! 1989 p 132-136 (For primary document see N92-22545 13-32)
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In May 1988, the World Administrative Radio Conference (WARC) for space services developed an allotment plan for certain fixed satellite service (FSS) bands. This paper will describe in detail the technical basis for the allotment plan, the reasoning behind the technical annexes associated with it, and some of the technical issues for implementation. The plan identifies orbital positions, service areas, and technical parameters for the various systems. The plan was developed using a set of standardized parameters based on typical systems. Flexibility to implement other parameters was achieved by defining generalized parameters, which are related to the interference causing and accepting capabilities of this typical set. Thus, implementation flexibility within defined limits is possible without coordination. If these limits are exceeded, implementation is still possible provided agreement is reached with those administrations affected as defined in the Final Acts. It is noted that sharing conditions with other services continue unchanged as in the current International Telecommunication Union (ITU) Radio Regulations. The criteria have provided considerable flexibility for Canadian usage. They did not affect the relative priority of services sharing the band, and coordination with terrestrial service will continue to be required. Author (CISTI)

N92-22566# Department of Communications, Ottawa (Ontario).
THE NEW INTERNATIONAL REGULATORY REGIME FOR THE FIXED SATELLITE SERVICE: OPPORTUNITIES AND CONSTRAINTS FOR CANADA
R. G. Amero, A. V. Carew, E. D. DuCharme, and A. D. McKay *In* Telesat Canada, The Future is Now! 1989 p 137-140 (For primary document see N92-22545 13-32)
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Frequencies used by Canadian satellite systems are coordinated internationally under the International Telecommunication Union (ITU) Radio Regulations. Fundamental changes in these regulations were made by the recent World Administrative Radio Conference (WARC) on the use of the geostationary satellite orbit and planning of space services utilizing it. WARC developed a new regulatory regime for the 6/4 GHz and 14/12 GHz bands currently used by Telesat Canada, and a different one involving a world a priori allotment plan for those portions of the 6/4 GHz and 13/10-11 GHz bands made available to the Fixed Satellite Service by the ITU General WARC in 1979. While these new regulations have been streamlined in some areas, overall the body of regulations pertaining to the fixed satellite service is much more complex, mainly as a result of demands by developing countries to have more assured access to these frequency bands and their wish to see portions of the orbit / spectrum resource reserved for their future use. The major features of these new regulatory procedures are described and the impact on the operation of current and future satellites will be identified. Author (CISTI)

N92-22567# Department of Communications, Ottawa (Ontario).
MOBILE SATELLITE SERVICES: THE QUEST FOR SPECTRUM
Murray J. Hunt and Ronald G. Amero *In* Telesat Canada, The Future is Now! 1989 p 141-144 (For primary document see N92-22545 13-32)
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The acquisition of suitable frequency spectrum at International Telecommunications Union (ITU) World Administrative Radio Conferences (WARCs) and access to it through international frequency coordination is vital to the success of commercial mobile satellite (MSAT) systems. Mobile satellite services were conceived in the late sixties as a means of providing reliable wide area communications to aircraft. Although this service did not come to fruition at that time, commercial maritime mobile satellite communications were inaugurated by Inmarsat some years later. The application in a domestic mobile satellite service context was extensively examined by the Department of Communications in the early eighties, which eventually led to the decision by Telesat Canada to assume responsibility for the project as a commercial venture and to the formation of Telesat Mobile Inc. (TMI). Each of these events is traced to the process of frequency allocation at WARCs. This paper also examines the complex international coordination activities related to MSAT. Finally, some preliminary thoughts are given on the importance of a future WARC component to deal with mobile satellite services, expected in the 1990s. Author (CISTI)

N92-22568# Syscor, Montreal (Quebec).
A CLOSED LOOP HYBRID INTERACTIVE SATELLITE NETWORK
John D. Goodchild *In* Telesat Canada, The Future is Now! 1989 p 147-151 (For primary document see N92-22545 13-32)
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Hybrid communication networks use a combination of satellite and terrestrial communication links to optimize the system. The major advantages of closed loop hybrid interactive satellite network technology are that it reduces the response time from that experienced in systems depending solely on geosynchronous orbiting satellites and avoids the requirement of having ground stations at every node in the network. This technology uses a T1 carrier to broadcast the outbound data to the user base which provides an enormous bandwidth and footprint, and telephone multiplexed high speed data lines for inbound data which have low bandwidth but can accommodate a large number of users. The major components of this technology are as follows. The network interface unit takes multiplexed outbound data, forms it into high level data link control (HDLC) packets and superimposes it onto a T1 carrier for transmission to the satellite uplink. The packetized outbound data is transmitted to the satellite. The satellite downlink receives the data and broadcasts to ground stations anywhere in the geographic boundaries of the satellite footprint. The data is then routed to the link access unit (LAU). The LAU demultiplexes the outbound data from the downlink and routes it to the user via RS232 protocol. Inbound traffic received by the LAU is multiplexed and transmitted over high speed synchronous data lines back to the network interfaces unit and on to the host computer. Author (CISTI)

N92-22569# International Datacasting Corp., Ottawa (Ontario).
HIGH-SPEED IMAGE TRANSMISSION VIA SATELLITE IN A WIDE-AREA NETWORK ENVIRONMENT
Michael W. Manson *In* Telesat Canada, The Future is Now! 1989 p 152-155 (For primary document see N92-22545 13-32)
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This paper examines the satellite implementation of wide-area image distribution networks. Data intensive applications benefit from satellite-based network implementation. Document image processing in a distributed environment is one application, requiring the high speed and flexibility of satellite communications. These systems typically consist of a large image database located on multiple optical disks in a jukebox, with associated scanning and printing capabilities. To this, workstations are connected locally via a local area network (LAN) or directly via a CPU access channel. Given the data intensive traffic that exists over the network and the centralized system implementation, high-speed, wide-area networking by satellite to service multiple remote users is an attractive solution. A point to multipoint, satellite-based, communications network that is designed specifically for data-intensive applications such as imaging is described. The system is characterized by a 512 kbits per second out-bound broadcast data channel, and terrestrial-based dial-up or X.25 service for inbound data transfer. By utilizing Ethernet bridges for LAN based imaging systems, and custom interfaces to CPU's and remote site workstations for direct-connect based image systems, wide-area image networks can easily be installed. These provide an enhancement to most document image processing applications. Author (CISTI)

N92-22570# Telesat Canada, Ottawa (Ontario). Communication Systems Engineering.
THE EFFECT OF CO-CHANNEL INTERFERENCE ON PROTOCOLS OVER MEDIUM RATE SATELLITE DATA LINKS
Ian A. McEachern *In its* The Future is Now! 1989 p 156-160 (For primary document see N92-22545 13-32)
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The increasing utilization of satellite communications services demands more and more effort to ensure co-existing services operate within acceptable levels of mutual interference. Telesat Canada is conducting on-going studies of the effect of co-channel video interference into data carriers. This paper studies the error rate statistics of data carriers in the presence of interference and calculates the effect of this interference on the high level data link control (HDLC) Go-Back-N and idealized selective repeat protocols by predicting performance using preliminary measured data. A comparison to calculations using a theoretical error model for satellite data circuits is also made. The results find that the theoretical model is more pessimistic and that satellite data users should expect to see up to 14-17 percent better throughput than theoretically predicted values. Author (CISTI)

N92-22571# Protocols Standards and Communication, Inc., Ottawa (Ontario).
IMPLEMENTING NETWORK PROTOCOLS OVER SATELLITE: A USERS PERSPECTIVE
Terrence Skemer and Grahame Aitken *In* Telesat Canada, The Future is Now! 1989 p 166-171 (For primary document see N92-22545 13-32)
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Today, many new communications networks/systems and existing value-added applications are being engineered or migrated to a satellite based environment. The data link and network interface protocols that are being used, for the most part, were originally designed for applications using point-to-point, terrestrial networking facilities. To apply these protocols to satellite links and to configure a working, user system end-to-end, a number of operational and equipment compatibility concerns must be realized and addressed. This paper discusses these concerns from a practical, implementation and networking perspective. The focus is on the operational and system compatibility issues associated with the common network interface protocols such as X.25, SNA, IBM 3270, IBM 3780, high level data link control (HDLC), and bisynchronous/asynchronous, being implemented over satellite facilities. A number of examples and solutions are presented.
Author (CISTI)

N92-22572# Department of Communications, Ottawa (Ontario). Mobile Satellite Terminal Development Group.
DESIGN CONSIDERATIONS FOR GENERAL AVIATION MOBILE SATELLITE TERMINALS
John T. Sydor *In* Telesat Canada, The Future is Now! 1989 p 190-194 (For primary document see N92-22545 13-32)
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Satellite mobile voice communications terminals for general aviation jets, helicopters, and propeller driven aircraft must be designed in a manner that will reduce the size, weight, and installation complexity of the terminal. Discrete radio frequency (RF) hardware components used to carry out signal transmission, reception, amplification, and filtering must be integrated through the use of microminiature microwave integrated circuitry (MMIC) or eliminated altogether. Terminal functions such as antenna beam forming and steering, Doppler shift elimination, automatic frequency correction, and the generation of high stability frequency references, will be achieved using relatively simple hardware in conjunction with adaptive controllers. Digital signal processing (DSP) microprocessors will be used for all terminal signal processing functions with the integration of control, modulation, and coding software. Ultimately the terminal will become two distinct physical layers. One being composed of a highly integrated RF front end that interfaces with a second layer providing DSP. Such terminals will be designed to minimize the effect on the aircraft's airframe, reduce installation time, and conform with all aviation certification requirements. Author (CISTI)

N92-22573# Transport Canada Aviation, Ottawa (Ontario).
AERONAUTICAL MOBILE SATELLITE SERVICE: AN OVERVIEW
Jack Rigley *In* Telesat Canada, The Future is Now! 1989 p 195-198 (For primary document see N92-22545 13-32)
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Successful flight trials of Aeronautical Mobile Satellite Services (AMSS) were first carried out in the 1960's but it is only in the past few years that plans to implement such a system have achieved any degree of certainty. System architecture has been agreed upon by users, service providers, and manufacturers. Detailed avionic characteristics have been approved and the International Civil Aviation Organization is currently preparing AMSS standards which will ensure the safety and regularity of international air traffic. In this paper, a review is provided of the history of AMSS, especially of Canadian participation, and a description of the technical and operational features of the system are given. The system will use the 1545-1555 and 1646.5-1656.5 MHz bands for satellite to aircraft and aircraft to satellite communication. Different categories of communication including air traffic control, aeronautical operational control, aeronautical administrative communications, and aeronautical passenger communication, will be assigned different priorities. A set of radio frequency (RF) channels have been defined to accommodate all foreseen traffic types. Standards for the avionics required for large passenger planes have been developed by the Airlines Electronic Engineering Committee. Author (CISTI)

N92-22574# International Datacasting Corp., Ottawa (Ontario).
BAND-EDGE UTILIZATION OF C-BAND VIDEO TRANSPONDER FOR HIGH SPEED DATA NETWORK
Stephen R. Todd and Jong-Soo Seo *In* Telesat Canada, The Future is Now! 1989 p 238-243 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

International Datacasting Corporation (IDC) has developed a 512 kbits per second C-band satellite transceiver that will operate using the band-edge of video transponders on commercial satellites such as the Anik D series. The system benefits users such as video transponder operators who wish to derive incremental revenue opportunities by expanding their services to include high speed data distribution for digital audio or local area network interconnection with no additional satellite costs. The band-edge system has been tested at IDC's facilities in Ottawa on Anik D1 with the technical support of Satellite Communications Inc. (CANCOM) and Telesat Canada. This paper describes the experimental results using IDC's 512 kbits per second superposed quadrature amplitude modulation (SQAM) transceiver equipped with 3/4 rate foreward error coding (FEC) codec. The discussion highlights the system parameters that optimized the data performance and maintained the video quality. The data link provided 99.8 percent error free minutes when the interference from the video carrier was minimized. Video picture and subcarrier quality were not affected by signal to noise ratio degradation due to intermodulation. This intermodulation could be eliminated by adjusting the video uplink level. The results support the use of SQAM as the digital modulation technique because of its excellent performance in a nonlinear and band-edge environment.
Author (CISTI)

N92-22575# Telesat Canada, Ottawa (Ontario).
TELESAT CANADA'S ANIK-E SPACECRAFT
E. Bertenyi *In its* The Future is Now! 1989 p 247-251 (For primary document see N92-22545 13-32)
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The dual band payload of the Anik E satellites, scheduled to begin launching in 1990, will replace two Anik C and two Anik D satellites at the end of their service life. This paper provides a summary of the features of the Anik E spacecraft and the principal system parameters, the spacecraft configuration, and the latest predictions concerning the communications performance of the spacecraft from the user's point of view. Comparison with the present Anik satellites is provided where applicable. The Anik-E is a large, high power, dual band, body stabilized spacecraft. The payload provided 24 C-band and 16 Ku-band operational channels. Ku-band channel switching enables selection of eastern or western Canada, national coverage, or enhanced cross border coverage. Linear orthogonal polarization is employed in both bands to allow frequency reuse. Deployable solar arrays will provide 4 kW or power and eclipse protection is provided by NiH2 batteries. The platform provides bipropellant liquid apogee engines and monopropellant electrothermal thrusters for north-south stationkeeping; pivoted momentum wheels and magnetic torquing for attitude control, and heat pipe thermal control. Anik E satellites have a projected service life of 10 years. Author (CISTI)

N92-22576# Telesat Canada, Ottawa (Ontario).
TRAFFIC PLANNING FOR THE ANIK-E SATELLITES
Douglas A. Gray *In its* The Future is Now! 1989 p 252-260 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Traffic planning is required to insure effective use of the dual band Anik E series of communications satellites. A trilateral orbital agreement reached with the United States and Mexico allows Canada four dual band satellite positions. This paper outlines the traffic planning process, describes satellite coordination, and provides highlights of the implementation of the Trilateral Orbital Plan. Constraints affecting traffic assignments include satellite health, the need for satellite diversity, and existing earth network facilities. Anik E will provide voice, television, and data communications over 24 C-band channels. Author (CISTI)

N92-22577# Department of Communications, Ottawa (Ontario).
EVALUATING THE USE OF SATELLITE COMMUNICATIONS IN THE GOVERNMENT OF CANADA
Howard L. Macumber and Oswald Hoch *In* Telesat Canada, The Future is Now! 1989 p 269-273 (For primary document see N92-22545 13-32)
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The Canadian Government Telecommunications Agency (GTA) has recently introduced the Government Satellite Network (GSN) for data, voice, and image communications. Three major field trials of this network have been undertaken, two involving time division multiple access (TDMA) and the third involving a single channel per carrier (SCPC) system. It was found that telecommunication delays experienced with single hop satellite communications had minimal effect but double hop systems seriously interfered with voice communications. The quality of transmitted facsimile images were equal or superior to those transmitted over terrestrial lines. Data transmission quality varied from excellent to unacceptable under moderate line loading. The SCPC system was used in trials involving the Canadian Coast Guard and the Air Administration. In an Air Administrative application, users were unable to differentiate between transmission over satellite and terrestrial channels. A demonstration has been established to enable government departments to evaluate satellite communications applications, and to verify essential aspects of system functionality and performance. Author (CISTI)

N92-22578# National Defence Headquarters, Ottawa (Ontario).
CANADIAN MILITARY SPACE ACTIVITY
Geoffrey W. Hodgson *In* Telesat Canada, The Future is Now! 1989 p 279-283 (For primary document see N92-22545 13-32)
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This paper outlines the Department of National Defence (DND) of Canada policy on the military use of space and discusses DND space systems. The NAVSTAR global positioning system will be the standard for future navigation systems. Canada is one of four founding nations of the international COSPAS/SARSAT satellite assisted search and rescue system. Three new earth stations will provide complete coverage of Canadian synthetic aperture radar (SAR) territory. In addition, funds have been committed for research and development of space based surveillance radar technology. The Canadian Forces Weather Service will receive digitalized satellite imagery and weather charts as part of the planned Meteorological Satellite Information System (METSIS). METSIS will provide weather information through Anik D satellite broadcast. A three phased approach is planned to satisfy satellite communications requirements. Leased point to point communications have been established for some locations. Mobile terminals are being developed and are being used to test technologies and operating techniques. Phase two will be the acquisition of a mix of fixed and mobile terminals to use existing commercial and military space bands. Encryption capabilities and antijamming technologies are being developed. Phase three calls for launching of several nongeostationary satellites to provide continuous coverage to the areas in the high Arctic which are below the horizon for geostationary satellites. DND policy can be summarized as follows: (1) the DND will enhance defence commitments by using space technology where appropriate and cost effective; (2) it will enhance the peaceful use of space; and (3) DND will use space programs to contribute to the Canadian economic and defence production base. Author (CISTI)

N92-22579# National Defence Headquarters, Ottawa (Ontario).
THE NORTH WARNING SYSTEM: A CANADIAN MILITARY SATCOM SUCCESS
Ivan J. Wawryk *In* Telesat Canada, The Future is Now! 1989 p 288-292 (For primary document see N92-22545 13-32)
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The strategic threat to North America presented by modern, supersonic bombers and long range cruise missiles has stimulated a modernization of atmospheric defence capability. The North Warning System (NWS), employs a chain of microwave radars across the Arctic and down the east coast of Canada to provide tactical warning and attack assessment information to NORAD and its forces. The responsibility for NWS facilities construction and communications is allocated to Canada. Earlier investigations in Canada and the U.S. had confirmed that an all satellite communications system to link the 47 Canadian NWS radars to command and control centers was more economical than any terrestrial alternative. A project was undertaken by the Canadian Department of National Defence (DND) to acquire and install an integrated, digital satellite communications system for the NWS. This paper outlines the project background and procurement process. System requirements and specifications are discussed and the communications system is described in some detail. The communications equipment will be required to function unmanned in extreme Arctic conditions for extended periods. Specifications called for a long haul communications network (LHCN), a maintenance control system to monitor and control the equipment, and a suite of on-site communications for each location. The LHCN is a fully integrated, redundant satellite system which employs a transponder on each of the Anik D satellites. Either transponder can carry the full communications load. The system is configured as a star network with the hub at North Bay. Five remote stations and the North Bay facility have been built in phase one of the project; the second phase will see the construction of 36 unattended stations across the Arctic and down the Baffin Island and Labrador coasts. Author (CISTI)

N92-22580# Lapp-Hancock Associates Ltd., Ottawa (Ontario).
AFTER ANIK-E: THE MARKETS AND THE TECHNOLOGY
Kenneth E. Hancock *In* Telesat Canada, The Future is Now! 1989 p 343-348 (For primary document see N92-22545

13-32)
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This paper deals with the likely developments in the market for telecommunications in the broadest sense. The impact of the potential universal personal telephone/data sets using integrated services digital network (ISDN) based technology is considered, as well as the impacts of high definition television, a mobile satellite service market encompassing land, marine, and aeronautical segments, and the potential impact of fiber optic links. Included in this portion of the paper are projections of regulatory change required to meet these new applications and technological trends. A Canadian communications satellite market hypothesis for a 12-15 year period commencing at the beginning of the 21st Century, (the approximate lifetime of an Anik F series of satellites) is then presented. Finally, the paper deals with the satellite technologies required to meet these needs. These include various types of on-board processing together with programmable beam shaping and beam switching. The likelihood of the replacements to Anik E following the trend of those satellites and using a hybrid configuration is considered, as is the possibility of a three or four frequency band satellite, utilizing the L, C, Ku, and Ka bands, possibly with cross band switchable strapping. Author (CISTI)

N92-22581# Microtel Pacific Research Ltd., Burnaby (British Columbia).
EHF SATCOM SYSTEM DESIGN
M. Jamil Ahmed *In* Telesat Canada, The Future is Now! 1989 p 349-352 (For primary document see N92-22545 13-32)
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Future satellite systems will differ considerably from the current versions. The impetus for change is a result of the need for more capacity, wider bandwidth requirements for enhanced services, increasing demand for mobile communications, advances in technology, developments in satellite payload systems, and a demand for secure military communications. To a large extent all of these needs can be satisfied by the use of extremely high frequency satellite communication (EHF Satcom) systems. EHF Satcom system design, features, pros and cons of using the system, particularly for military applications, and the current status of EHF SATCOM in Canada, U.S., Europe, and Japan are examined. The demand for bandwidth will continue to increase due to the growth of communication as well as due to enhanced services for business and entertainment. The increased bandwidth needs will be met by operating at higher frequencies, and perhaps by using extremely high frequency/superhigh frequency (EHF/SHF) satellites. Design of such systems involves a consideration of numerous aspects of design, technology, cost, and services. Advances in technology will make EHF/SHF systems feasible for military applications, as well as commercial mobile terminals, and high data rate terminals. The use of higher frequencies and small antennas will aid mobile communications. On-board processing will be akin to putting a switch in the space, providing flexibility of rates, connectivity, and services. Author (CISTI)

N92-22582# Department of Communications, Ottawa (Ontario).
THE OLYMPUS PROGRAM: A CANADIAN OPPORTUNITY
G. H. Booth, E. J. Hayes, R. Mamen, R. L. Olsen, and E. K. Tsang *In* Telesat Canada, The Future is Now! 1989 p 353-357 (For primary document see N92-22545 13-32)
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Canada was involved in the European Space Agency's Olympus satellite program since the beginning. Canadian industry was responsible for the design and manufacture of the large solar array system, intermediate frequency amplifiers, and microwave components as well as playing an important role in the assembly, integration, and test of the satellite and test models which were largely conducted at the Department of Communications' David Florida Laboratory (DFL). This paper describes the salient features of the satellite, special aspects of the testing at the DFL that were driven by the Olympus program, and Canada's part in the post-launch trials and demonstration program which provides Canada with an early opportunity to experiment in the next frequency band to be exploited commercially. The Olympus satellite is a multipurpose three axis stabilized bus capable of carrying a variety of payloads. It has a flexible solar array capable of generating 3.5 kW of power. The multielement payload of the first Olympus satellite includes the following: a two channel, high power television broadcast payload, a four channel 12/14 GHz payload for business services, a 20/30 GHz communications payload primarily aimed at video conferencing and communications systems, and 12/30/30 GHz beacon which will be used to gather propagation information. Testing at the DFL included thermal, vibration, and mass properties measurements and radio frequency testing.
Author (CISTI)

N92-22583# Communications Research Centre, Ottawa (Ontario).
ON-BOARD PROCESSING IN FUTURE COMMUNICATIONS SATELLITES
C. Loo, E. J. Hayes, and J. G. Chambers *In* Telesat Canada, The Future is Now! 1989 p 358-363 (For primary document see N92-22545 13-32)
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One of the more promising signal processing schemes for satellite communications, the use of phase shift keyed/frequency division multiple access (PSK/FDMA) for the uplink and time division multiplexing (TDM) for the downlink is described. This multiple access method allows ground terminals and satellite transponder power amplifiers all to operate at saturation for maximum power efficiency. On-board processing is accomplished via group demodulation of the PSK/FDMA signal. The group demodulator maps the PSK/FDMA signal into a TDM signal by means of a Fourier transformer. There are two general approaches to realizing the Fourier transform. This first is based on digital signal processing using a fast Fourier transform algorithm which is also known as a digital transmultiplexer. The second one uses a chirp Fourier transform approach, implemented by means of surface acoustic wave (SAW) devices. These two approaches, together with some results, are described in the paper. A planned experiment in on-board processing, using double-hop on the Olympus Ka-band repeater is described. Author (CISTI)

N92-22584# Communications Research Centre, Ottawa (Ontario).
CANADIAN EHF (28/19 GHz) SATELLITE COMMUNICATION TERMINALS FOR THE OLYMPUS PROGRAM
C. J. Pike, D. R. Bradley, and D. J. M. Hindson *In* Telesat Canada, The Future is Now! 1989 p 364-369 (For primary document see N92-22545 13-32)
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Researchers at the Communications Research Center (CRC) are actively developing extremely high frequency (EHF) technology for the development of the Olympus satellite terminals. The specifications and performance evaluation of the terminals are presented from the radio frequency (RF) perspective as well as the digital approach using 70 MHz modems. Terminals constructed at CRC will be used to conduct experiments in the areas of rain fade countermeasures using an adaptive data rate transmission technique, in on-board processing (OBP) that will be demonstrated in a double-hop configuration using a surface acoustic wave demodulator, and in other user trials related to tele-education, and tele-medicine. Phase shift keyed (PSK) modems will be used for the rain fade countermeasures experiment. Terminals will also be used for demonstrations of point-to-point communications applicable to private business, tele-education and tele-medicine networks. Author (CISTI)

N92-22585# Department of Communications, Ottawa (Ontario).
SATELLITE COMMUNICATIONS IN CANADA: A DOC PERSPECTIVE
Richard Stursberg *In* Telesat Canada, The Future is Now!

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The role of the Canadian government and, in particular, of the Department of Communications (DOC) in the evolution and growth of the Canadian communications satellite industry is discussed. Activities by DOC which affect communications technology include the following: (1) DOC undertakes research and development of enabling technologies; (2) promotes the use and diffusion of these technologies through applications development; (3) negotiates spectrum and orbit arrangements in the domestic and international arena; (4) assists in the promotion and marketing of Canadian technologies abroad; and (5) has overall responsibility of telecommunications policy including development of standards and regulations. A brief description is provided of global factors which are expected to affect technology and applications development in the near future. Strategic program reviews undertaken by the Satellite Communications Application Program, the research and development program, and the Government Telecommunications Agency are described.
Author (CISTI)

N92-22586# Comtel, Santa Maria, CA.
COST EFFECTIVE METHODS FOR NETWORK DIVERSITY AND SERVICE RESTORAL
S. S. Kamal and Keith Dunford *In* Telesat Canada, The Future is Now! 1989 p 449-455 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

An approach, based on hybrid network architecture, to disaster prevention and restoral of communication services after catastrophic loss is described. Terrestrial communication networks depend on microwave link detours, portable data switches, and ring architectures to provide disaster protection. The weakness of such systems includes the probability that alternate paths will share right of way, and reliance on the survival of the processing center. Hybrid diversity architectures combine satellite with terrestrial communications routes. These architectures require that each of the load sharing communications links be able to emulate the other. Two major architectures dominate hybrid systems. (1) Host center backup is the most common system. Here satellite links are used to backup the catastrophic loss of the primary data center. It is limited to point to point and very small aperture terminals networks. (2) Total superimposed telecommunications systems are more flexible. They involve an intelligent satellite superimposed on a terrestrial system. Any one node in the terrestrial system can access a satellite when routing outbound or inbound messages. These systems provide reliable backup for all terrestrial network architectures including star architectures; are non-centralized, yielding to no single point of failure; allow voice and data communication to be pooled for allocation efficiency; can easily be reconfigured in emergencies; and can share peak loads to minimize overall system costs.
Author (CISTI)

N92-22587# National Defence Headquarters, Ottawa (Ontario).
ANIK-E COMMAND LINK SECURITY
David C. Leal *In* Telesat Canada, The Future is Now! 1989 p 456-459 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The government of Canada is increasingly dependant on domestic satellite circuits for communications links to remote sites. Consequently, the satellites are vital points requiring protection from hostile adversaries. As a first step in providing this protection, the Department of National Defence, in conjunction with Telesat, considered the potential threats to the Anik satellites, and the measures that could be taken to overcome them on future satellites. After thorough analysis, it was determined that the command link of the new Anik E series of satellites could and should be protected against jamming and illicit commanding. The command link was placed in a narrow spot beam focused on the legitimate ground control stations to combat the jamming threat, and the command link will be encrypted to defeat illicit commanding. Security and redundancy at the ground control sites is also being increased. The Anik E command link will be better protected than the command link of any other commercial satellite communications system now in operation in North America.
Author (CISTI)

N92-22588# Telesat Canada, Ottawa (Ontario).
AMAC: TELESAT'S APPROACH TO SUPERVISORY CONTROL
Arlene E. Rowe *In its* The Future is Now! 1989 p 491-494 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

Details are provided of the design objectives and implementation of an automated computer supervisory system designed to monitor and control telecommunications equipment at remote earth stations from a central earth station. These earth stations contain equipment required to transmit and receive voice and data transmissions from communications satellites. The configuration of the Alarm Monitoring and Control (AMAC) system consists of a central control computer (CCC) located at Satellite Network Operations Center and remote terminals which monitor equipment in the remote earth station and relay pertinent information to the CCC. In addition they receive commands from the CCC and relay them to the appropriate item of equipment. The present system operates over public telephone lines but eventually communication will be over public lines, dedicated lines, or satellite. Operators at the operations center are automatically notified when an alarm condition exists on a remote terminal. In addition, the system allows operators at the network operations center to query equipment, change parameters, reset equipment, or retune transmitters and receivers in remote locations.
Author (CISTI)

N92-22589# Telesat Canada, Ottawa (Ontario).
HEALTHY SATELLITES PROVIDE QUALITY SERVICE
Paul Margittai *In its* The Future is Now! 1989 p 495-499 (For primary document see N92-22545 13-32)
Avail: Secretariat Office, P.O. Box 7190, Ottawa, ON K1L 8E3 Canada

The procedures used by Telesat Canada to ensure the performance of Anik satellites is described. At the Satellite Telemetry, Tracking and Command station, each Anik satellite has its own dedicated antenna. Telemetered information from the satellites is received, processed and forwarded to the Satellite Control Center. There the satellite controllers issue all commands to the satellites, and continually monitor the telemetered data. These data, describing the state of health of the satellites, are then analyzed by engineering specialists. The satellites are held in their precise orbital positions by means of specially developed software. The Anik C and D satellites employ travelling wave tube amplifiers (TWTAs) in the transpounder channels. The TWTA saturated flux density (SFD) and equivalent isotropic radiated power (EIRP) are regularly measured and their trends scrutinized. This ensures that customers receive the radio frequency power needed for high-quality service. The satellite electrical power is supplied by the solar cell array and batteries. Power system performance is evaluated regularly to ensure that power is available to operate the required number of TWTAs. In addition to rain-fades, short service interruptions can be caused by high voltage trip-offs of TWTAs, and by electrostatic discharge related anomalies. To minimize these interruptions, Telesat ensures that the satellite controllers are fully trained and prepared for any eventuality, and the relevant operational procedures are continually refined. A fully trained staff of satellite controllers keep interruptions caused by high voltage trip-offs of TWTAs and by electrostatic discharge to a minimum.
Author (CISTI)

N92-22594# Helsinki Univ. of Technology, Espoo (Finland). Radio Lab.
NEAR-FIELD ANALYSIS OF A THICK LENS AND HORN COMBINATION: THEORY AND MEASUREMENTS

J. Tuovinen, T. Hirvonen, and A. Raeisaenen Apr. 1991 24 p
(PB92-142041; ISBN-951-22-0587-4; S-189) Avail: NTIS
HC/MF A03 CSCL 20N

At millimeter waves quasi-optical systems are commonly designed based on the Gaussian beam and thin lens approximation. The accuracy of the Gaussian beam and thin lens approximation was studied in the case of a corrugated horn and lens combination at 87 giga-Hz. A special near field measurement system was constructed. Large disagreement between the measured and theoretical values were obtained with the approximative method. A more accurate theoretical model was developed based on ray tracing and use of Huygens' principle. The theoretical values obtained with the method agree well with the measurements.
Author

N92-22609# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
VECTOR TRANSMISSION-LINE AND CIRCUIT THEORY FOR BIISOPTROPIC LAYERED STRUCTURES
I. V. Lindell, S. A. Tretyakov, and M. I. Oksanen Oct. 1991 32 p
(PB92-143353; ISBN-951-22-0836-9; Rept-105) Avail: NTIS
HC/MF A03 CSCL 20N

Vector transmission line theory is introduced for problems involving plane wave propagation, reflection, and transmission in multilayered general bi-isotropic structures. The structure is replaced by a transmission line with vector voltage and current quantities and dyadic line parameters. The characteristic admittance and propagation factor are both dyadic quantities, which have different expressions for waves propagating in opposite directions along transmission lines. Vector circuit theory, developed earlier for plane wave propagation and reflection problems in layered chiral and general bi-isotropic structures is formulated in terms of the vector transmission line parameters. The theory is verified by checking special cases. It is claimed that, with the present formalism, analysis can be done more systematically, with less effort and particular results can be memorized more easily than when operating with scalar component quantities. Numerical examples show new and interesting results indicating possible applications of bi-isotropic slabs. GRA

N92-22634# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
COHERENT POTENTIAL APPROACH ON THE EFFECTIVE PERMITTIVITY OF MIXTURES WITH INHOMOGENEOUS SCATTERERS: COMPARISON OF TWO THEORIES
A. H. Sihvola Aug. 1990 15 p
(PB92-142124; ISBN-951-22-0344-8; Rept-69) Avail: NTIS
HC/MF A03 CSCL 20N

The communication focuses on the effective permittivity of a mixture that consists of a background medium in which layered spherical scatterers are randomly embedded. For dense nontenuous media the quasicrystalline approximation has been supplemented with the coherent potential approach. For the effective permittivity or the effective propagation constant. two theories have been published (References (1) and (2)). The paper compares the predictions of these theories and proves that they are consistent. GRA

N92-22635# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
GENERALIZED WKB APPROXIMATION FOR STRATIFIED ISO-TROPIC CHIRAL MEDIA WITH OBLIQUELY INCIDENT PLANE WAVE
A. J. Viitanen, I. V. Lindell, and A. H. Sihvola Aug. 1990 26 p
(PB92-142132; ISBN-951-22-0354-5; Rept-71) Avail: NTIS
HC/MF A03 CSCL 20N

The Wentzel-Kramer-Brillouin (WKB) method and its generalization are extended to stratified chiral media for waves with oblique incidence. Wave propagation in chiral media inhomogeneous in one space coordinate is considered through normalized wave fields, certain combinations of the electric and magnetic fields, which are slightly coupled in slightly inhomogeneous media. By omitting the coupling leads to the WKB solution for waves propagating without reflection. The reflection effect is obtained as a first-order correction to the WKB solution. For sufficiently slowly varying media, the reflection dyadic due to the stratification can be expressed in closed integral form. GRA

N92-22636# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
GREEN DYADIC FOR THE GENERAL BI-ISOTROPIC (NONRECIPROCAL CHIRAL) MEDIUM
I. V. Lindell and A. J. Viitanen Oct. 1990 12 p
(PB92-142140; ISBN-951-22-0429-0; Rept-72) Avail: NTIS
HC/MF A03 CSCL 20N

Expression for the Green dyadic corresponding to the general homogeneous bi-isotropic medium is derived. The solution is seen to have a close similarity to that of the usually analyzed chiral medium, which is actually the reciprocal special case of the general bi-isotropic medium. The general bi-isotropic, or nonreciprocal chiral, medium contains an added parameter when compared to the reciprocal chiral medium, allowing more freedom for the design of antennas and microwave components. In addition to making nonreciprocal devices possible, the added nonreciprocity also enhances the effect of chirality. GRA

N92-22638*# Ohio State Univ., Columbus. ElectroScience Lab.
NEAR ZONE: BASIC SCATTERING CODE USER'S MANUAL WITH SPACE STATION APPLICATIONS
R. J. Marhefka and J. W. Silvestro Dec. 1989 378 p
(Grant NsG-1498)
(NASA-CR-181944; NAS 1.26:181944; ESL-716199-13) Avail: NTIS HC/MF A17 CSCL 20N

The Electromagnetic Code - Basic Scattering Code, Version 3, is a user oriented computer code to analyze near and far zone patterns of antennas in the presence of scattering structures, to provide coupling between antennas in a complex environment, and to determine radiation hazard calculations at UHF and above. The analysis is based on uniform asymptotic techniques formulated in terms of the Uniform Geometrical Theory of Diffraction (UTD). Complicated structures can be simulated by arbitrarily oriented flat plates and an infinite ground plane that can be perfectly conducting or dielectric. Also, perfectly conducting finite elliptic cylinder, elliptic cone frustum sections, and finite composite ellipsoids can be used to model the superstructure of a ship, the body of a truck, and airplane, a satellite, etc. This manual gives special consideration to space station modeling applications. This is a user manual designed to give an overall view of the operation of the computer code, to instruct a user in how to model structures, and to show the validity of the code by comparing various computed results against measured and alternative calculations such as method of moments whenever available. Author

N92-22781# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
DISPERSION CURVES AND FIELDS FOR A CHIRAL SLAB WAVEGUIDE
M. Oksanen, P. K. Koivisto, and I. V. Lindell Nov. 1990 25 p
Sponsored by Suomen Akatemja, Helsinki
(PB92-142157; ISBN-951-22-0432-0; Rept-75) Avail: NTIS
HC/MF A03 CSCL 20N

The paper discusses wave propagation and field distributions in slab dielectric waveguides having homogeneous isotropic chiral material. The analysis is based on field expansions in the guide and in the upper and lower half spaces. Enforcing the boundary conditions at the waveguide interfaces results in eigenvalue equations for the hybrid propagating and guided modes. The theory is illustrated by calculating dispersion curves and field distributions for weakly guiding chiral slab waveguides. GRA

N92-22782# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
DUALITY TRANSFORMATIONS FOR GENERAL BI-ISOTROPIC (NONRECIPROCAL CHIRAL) MEDIA

I. V. Lindell and A. J. Viitanen Nov. 1990 16 p
(PB92-142165; ISBN-951-22-0460-6; Rept-78) Avail: NTIS HC/MF A03 CSCL 20N

Duality transformation is considered for the general bi-isotropic (nonreciprocal chiral) medium. The transformation is defined to have a given bi-isotropic medium self dual, or invariant, in this transformation. It is shown that the transformation always exists in pairs, labeled as left-hand and right-hand duality transformations. Self-dual fields, are seen to be generalizations of the wave fields E(sub + over -) applied in the analysis of reciprocal chiral media. Plane wave fields in bi-isotropic media are seen to be self dual and their reflection and transmission properties are considered. It is seen that the nonreciprocity gives rise to polarization rotation in reflection while the chirality is known to rotate the polarization of a propagating field. GRA

N92-22783# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.

VARIATIONAL METHOD FOR THE ANALYSIS OF LOSSLESS BI-ISOTROPIC (NONRECIPROCAL CHIRAL) OPEN WAVEGUIDES

I. V. Lindell May 1991 14 p
(PB92-142181; ISBN-951-22-0642-0; Rept-93) Avail: NTIS HC/MF A03 CSCL 20N

Equations are derived for the longitudinal fields of a propagating mode in the most general straight open waveguide structure made from the most general lossless linear material whose parameters are independent of its orientation. This material, also called bi-isotropic, has the important chiral medium as the reciprocal special case. Self-adjointness of the differential operator with respect to the hermitian inner product is confirmed. Applying the theory of nonstandard eigenvalue problems, a variational expression is derived for the solution of the waveguide problem. Procedures for its application are discussed. GRA

N92-22784# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.

WKB APPROXIMATION FOR STRATIFIED BI-ISOTROPIC MEDIA

A. J. Viitanen Dec. 1990 19 p
(PB92-142363; ISBN-951-22-0480-0; Rept-80) Avail: NTIS HC/MF A03 CSCL 20N

The Wentzel-Kramer-Brillouin (WKB) method is applied to wave propagation in stratified bi-isotropic media, or nonreciprocal chiral media, for waves with normal incidence. The method is based on the expansion of self-dual fields, which are certain combinations of the electric and magnetic fields. The propagating fields are derived with WKB method. For sufficiently slowly varying media, the reflected fields are obtained as a first-order correction to the WKB solution. For normal incidence, the reflection effect is independent of the chirality parameter kappa but depends on the Tellegen parameter chi. GRA

N92-22789# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.

POLARISABILITIES AND MAXWELL-GARNETT FORMULAE FOR BI-ISOTROPIC SPHERE

A. H. Sihvola Feb. 1991 11 p
(PB92-142389; ISBN-951-22-0540-8; Rept-84) Avail: NTIS HC/MF A03 CSCL 20N

The communication focuses on the generalization of chiral media, the general bi-isotropic media. The electric and magnetic co and cross polarizabilities of a bi-isotropic sphere are derived using these, the generalized Maxwell-Garnett formulae follow for the effective material parameters of a mixture where these types of spheres are embedded in an isotropic background material. In addition to permittivity, permeability, and chirality, the fourth effective parameter, nonreciprocity appears. GRA

N92-22969# National Lab. for High Energy Physics, Tsukuba (Japan).

USER'S GUIDE TO DENKAI

Tsumoru Shintake Jun. 1991 26 p
(DE92-751022; KEK-91-3) Avail: NTIS HC/MF A03

DENKAI is a set of computer programs to calculate the 2-dimensional electrostatic field with cylindrical symmetry. Using simple commands, triangle meshes are automatically generated in the MESH GENERATOR routine. The bandwidth of the coefficient matrix is reduced in the BAND WIDTH routine. The Laplace equation of the electrostatic field is solved in the FIELD routine by inverting the coefficient matrix using Gauss method. The electric field lines are plotted by the FIELD PLOT routine, and the electric field intensities on arbitrary boundary can be read out by the FIELD LIST routine. DOE

N92-23098 British Broadcasting Corp., Kingswood (England). Engineering Div.

RDS-ALERT: A PROPOSED TRAFFIC MESSAGE CHANNEL (TMC) FEATURE FOR THE RADIO DATA SYSTEM (RDS)

J. L. Riley and A. K. McParland 1991 29 p
(BBC-RD-1991/16) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Radio Data System Traffic Message Channel RDS-TMC is a proposed new feature for FM radio (VHF) which provides a means for conveying travel information in a densely coded digital form, along with a conventional VHF-FM program signal, such that it is independent of the normal sound program. Using TMC, special RDS receivers employ decoding circuitry and digital storage to retrieve the messages and store them for future interrogation by a listener. This report explains the objective, operation, development, and testing of this system. H.A.

N92-23099 British Broadcasting Corp., Kingswood (England). Engineering Div.

RADIO-CAMERAS: THE DEVELOPMENT OF RADIO SYSTEMS FOR PORTABLE CAMERAS USED IN TELEVISION PRODUCTION

C. Gandy 1991 28 p
(BBC-RD-1991/15) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

In its simplest form, a single operator radio camera system uses a small microwave transmitter with an omnidirectional antenna, attached to the camera. This provides the required insensitivity to the orientation of the camera but multipath propagation of the radio signal can seriously degrade the received television pictures. Investigation of means to combat multipath propagation has been the subject of an intensive program of work, and has resulted in the development of special transmitting antennas which use circular polarization, as well as a novel tracking system using directive antennas. This report describes this work starting with an outline of the various configurations for the radio camera system covering the history of its use. Theoretical and practical aspects are then discussed, and descriptions are given of the current 2.5 giga-Hz and 12 giga-Hz systems, and the new switched antenna system which is presently being developed. H.A.

N92-22432*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

COMMERCIAL APPLICATIONS OF THE ACTS MOBILE TERMINAL MILLIMETER-WAVE ANTENNAS

Arthur C. Densmore, Rick A. Crist, Vahraz Jamnejad, and Ann N. Tulintseff *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 67-71 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17B

N92-22433*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ANTENNAS FOR MOBILE SATELLITE COMMUNICATIONS

John Huang *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 72-81 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17B

N92-22434*# Pacific Monolithics, Inc., Sunnyvale, CA.
MMIC LINEAR-PHASE AND DIGITAL MODULATORS FOR DEEP SPACE SPACECRAFT X-BAND TRANSPONDER APPLICATIONS
Narayan R. Mysoor and Fazal Ali *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 82-88 Prepared for Jet Propulsion Lab., California Inst. of Tech., Pasadena (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17B

N92-22435*# Hughes Aircraft Co., El Segundo, CA. Space and Communications Group.
PHASED ARRAY ANTENNA BEAMFORMING USING OPTICAL PROCESSOR
L. P. Anderson, F. Boldissar, and D. C. D. Chang *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 89-98 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17B

N92-22719*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OPERATIONS AUTOMATION USING TEMPORAL DEPENDENCY NETWORKS
Lynne P. Cooper *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 386-393 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 17B

N92-22792*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
SENSING PROPAGATION EVENTS AND FADE STATISTICS AT C-BAND FOR TWO OVER-WATER, LINE-OF-SIGHT PROPAGATION PATHS OVER A ONE YEAR PERIOD
Julius Goldhirsh, G. Daniel Dockery, and Bert H. Musiani *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 12 p Sponsored by NASA. Wallops Flight Facility (For primary document see N92-22790 13-46)
(Contract N00039-89-C-0001)
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N92-22794# Centre d'Electronique de l'Armement, Bruz (France). Div. ASRE.
OVER THE HORIZON PROPAGATION IN A MARINE ENVIRONMENT: MODELLING AND RECENT EXPERIMENTAL RESULTS
Jacques Claverie and Yvonick Hurtaud *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 14 p In FRENCH (For primary document see N92-22790 13-46)
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N92-22795# Centre d'Etudes et de Recherches, Toulouse (France). Departement Micro-Ondes.
A THEORETICAL STUDY OF A RADIOWAVE CHARACTERIZATION METHOD OF THE EVAPORATION DUCT
N. Douchin, S. Bolioli, F. Christophe, and P. Combes (Toulouse Univ., France) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 15 p In FRENCH; ENGLISH summary (For primary document see N92-22790 13-46)
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N92-22796# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
RADIO REFRACTIVITY PROFILES DEDUCED FROM AEROSOL LIDAR MEASUREMENTS
H. G. Hughes, M. R. Paulson, and J. H. Richter *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p Sponsored by Office of Naval Technology (For primary document see N92-22790 13-46)
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N92-22797# Rutherford Appleton Lab., Chilton (England). Radio Communications Research Unit.
USE OF MESOSCALE MODELS FOR REFRACTIVITY FORECASTING
M. F. Levy and K. H. Craig *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 12 p Sponsored by Ministry of Defence (For primary document see N92-22790 13-46)
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N92-22798# Pacific Missile Test Center, Point Mugu, CA.
REFRACTIVE ASSESSMENTS FROM SATELLITE OBSERVATIONS
Jay Rosenthal and Roger Helvey *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)
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N92-22814# Atmospheric Sciences Lab., White Sands Missile Range, NM.
FAR-INFRARED CHARACTERIZATION OF HORIZONTAL PATH IMAGE DEGRADATION
Wendell R. Watkins *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 11 p (For primary document see N92-22790 13-46)
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N92-22820# Forschungsinstitut der Deutschen Bundespost, Darmstadt (Germany, F.R.).
DIGITAL CHANNEL SOUNDER FOR REMOTE SENSING OF SCATTERERS IN MOBILE RADIO ENVIRONMENT
Rudolf Werner Lorenz and Gerhard Kadel *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)
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N92-22821# Illinois Univ., Chicago. Communications and Sensing Lab.
BASIC EQUATIONS OF RADAR POLARIMETRY AND SOLUTIONS THE SENSING OF PROPAGATION PATH POLARIZATION STATE CHANGES
Wolfgang-Martin Boerner, Wei-Ling Yan, An-Qing Xi, and Yoshio Yamaguchi (Niigata Univ., Japan) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)
(Contracts N00014-80-C-0773; N00014-90-J-1405; DAAL03-89-K-0116)
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N92-22822# Niigata Univ. (Japan). Faculty of Electronics.
ADAPTIVE COMMUNICATIONS POLARIMETRY: SENSING OF PROPAGATION PATH CHANGES AND ADAPTATION TO OPTIMAL PERFORMANCE IN CELLULAR COMMUNICATIONS
Yoshio Yamaguchi, Hyo Joon Eom, and Wolfgang-Martin Boerner (Illinois Univ., Chicago.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)
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N92-22825# Centre National d'Etudes des Telecommunications, Lannion (France).
A CALIBRATION TECHNIQUE FOR THE CNET HF BACKSCATTER RADAR

N. Ruelle, F. Gauthier, J. Y. LeSaout, L. Bertel, and V. Baltazart (Rennes Univ., France) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)
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33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N92-22134# Beckwith Electric Co., Inc., Largo, FL.
MULTIFUNCTION PROTECTIVE RELAY Final Report, Oct. 1988 - Nov. 1991
J. Harlow, M. Yalla, and J. Kantor Nov. 1991 85 p
(Contract GRI-5088-293-1691)
(PB92-132919; GRI-91/0355) Avail: NTIS HC/MF A05 CSCL 09A

Since the enactment of the National Energy Act of 1979, many private energy producers have been planning and building small generation and cogeneration facilities in order to sell power to the local utility. Many of the non-utility generators built after 1979 are connected directly to the closest utility distribution circuit. Aware of the problems associated with connecting generators in this manner, electric utilities across the country developed specifications and standards to allow safe and reliable interconnection. The report describes a malfunction protective relay which uses state-of-the-art digital signal processing procedures to accomplish the objective of providing most of the relay requirements of utility electrical interconnections. The relay has been demonstrated to be suitable for this critical application through extensive laboratory and in-service field testing. The relay, incorporating thirteen distinct protection functions affords the user the savings of the initial capital cost plus simplicity of installation and use. GRA

N92-22245# EIC, Inc., Norwood, MA.
ACTIVE MINE BATTERIES WITH LONG SHELF-LIFE. PART 1: DEVELOPMENT OF Li-ION CONDUCTING POLYMERIC ANODE FILMS Final Report, Jun. - Dec. 1990
K. M. Abraham, D. M. Pasquariello, M. Hart, and W. P. Kilroy 10 Apr. 1991 58 p
(AD-A245052; NAVSWC-TR-91-20) Avail: NTIS HC/MF A04 CSCL 07/4

The Li/SOCl2 chemical couple represents the highest energy density electrochemical cell presently available, both with respect to volume and weight. The cell has an open circuit potential of 3.65V, a theoretical gravimetric energy density of 670 Wh/lb (1470 Wh/Kg), and a volumetric energy density of 33 Wh/cu in (2.0 Wh/cu cm). Energy densities of up to 300 Wh/lb and 21 Wh/cu in have been realized in practical D size Li/SOCl2 cells. Despite the attractive features such as high energy density, high load voltage and wide operational temperature range, some important problems persist hindering its widespread application. Notable among these is voltage delay, i.e., the initial depression of the cell voltage below 2.0 V on load after prolonged storage, especially storage at 70 C followed by discharge at high rates and low temperatures. The Li anode instantaneously forms a protective film of LiCl on its surface when it comes in contact with the SOCl2/LiAlCl4 electrolyte. Although the reaction of Li and SOCl2 is strongly favored by thermodynamics, the formation of this LiCl film passivates the Li, kinetically hindering the reaction. Prolonged storage of the cell leads to an increase in the thickness of the LiCl film, and voltage delay is associated with this passivating film. GRA

N92-22291# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOY. USSR: ELECTRONICS AND ELECTRICAL ENGINEERING
11 Jul. 1991 34 p Transl. into ENGLISH from various Russian articles
(JPRS-UEE-91-005) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in electronics and electrical engineering. Topics covered include broadcasting, consumer electronics, antennas, wave propagation, circuits, computers, power engineering, quantum electronics, and electro-optics. Author

N92-22292# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ELECTRONICS AND ELECTRICAL ENGINEERING
26 Jul. 1991 32 p Transl. into ENGLISH from various Russian articles
(JPRS-UEE-91-006) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in electronics and electrical engineering. Topics covered include broadcasting, consumer electronics, circuits, rail transportation, detectors, aerospace electronic systems, industrial electronics, control instrumentation, computers, radio communication, power engineering, electrical insulation, electro-optics, and quantum electronics. Author

N92-22294# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ELECTRONICS AND ELECTRICAL ENGINEERING
29 Jan. 1991 32 p Transl. into ENGLISH from various Russian articles
(JPRS-UEE-91-001) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in electronics and electrical engineering. Topics covered include consumer electronics, broadcasting, antennas, ionospheric propagation, circuits, industrial electronics, control instrumentation, power engineering, quantum electronics, and electro-optics. Author

N92-22313# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ELECTRONICS AND ELECTRICAL ENGINEERING
3 Jan. 1991 37 p Transl. into ENGLISH of various Russian articles
(JPRS-UEE-90-013) Avail: NTIS HC/MF A03

A bibliography is given of USSR research in electronics and electrical engineering. Topics covered include broadcasting, consumer electronics, antennas, wave propagation, optical communication, industrial electronics, communication cable, fiber optics, manufacturing technology, power engineering, quantum electronics, electro-optics, and solid state circuits. Author

N92-22400# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ELECTRONICS AND ELECTRICAL ENGINEERING
13 Jun. 1991 36 p Transl. into ENGLISH from various Russian articles
(JPRS-UEE-91-004) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in electronics and electrical engineering. Topics covered include broadcasting, consumer electronics, antennas, wave propagation, circuits, rail transportation, computers, telephone service, and power engineering. Author

N92-22403# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: ELECTRONICS AND ELECTRICAL ENGINEERING
26 Mar. 1991 47 p Transl. into ENGLISH from various Russian articles
(JPRS-UEE-91-003) Avail: NTIS HC/MF A03

A bibliography is given of U.S.S.R. research in electronics and electrical engineering. Topics covered include broadcasting, consumer electronics, circuits, rail transportation, communication networks, computers, and power engineering. Author

N92-22414# Technische Univ., Delft (Netherlands).
ON THE THROUGHPUT OPTIMIZATION OF ELECTRON BEAM LITHOGRAPHY SYSTEMS Ph.D. Thesis
Elvira Hendrika Mulder 1991 275 p
(ETN-92-91140) Avail: NTIS HC/MF A12

An investigation into the optimization of the writing speed for Electron Beam Lithography (EBL) systems is presented. Attention is focused on reducing the dead times, which occur when the EB is switched off. Calculations were done for a paper lithography system with 100 keV, EBs, for which the probe current (10 microA) and the resist sensitivity (0.1 C/sq cm) were optimized for the exposure of 0.1 micrometer patterns. The goal was to investigate the feasibility of a 1 sq cm/s writing speed for such patterns. Further increase of throughput writing strategy optimization and optimization of the deflect design for speed are investigated. A basis for deflector design is given and positioning deflection system and electron beam shaper design are described. The design of the deflectors in the shaper is described. Prototypes were made and test results are presented. ESA

N92-22657# New Energy Development Organization, Tokyo (Japan).
STUDY FOR PROMOTION OF INTRODUCING ADVANCED BATTERY ENERGY STORAGE SYSTEMS
Mar. 1991 97 p In JAPANESE; ENGLISH summary
(DE92-769389; NEDO-P-9026) Avail: NTIS HC/MF A05

An advanced battery energy storage system is examined, with studies focused mainly on its technical development, but also its commercialization, cost, reliability, simplification and compactness. The purpose of this project is to study the parameters which are needed in order to promote introduction of the advanced battery energy storage system. Systems which are expected to be commercialized in the near future are a customer peak-cut system, an isolated island peak-cut system, and emergency electric power sources. When technology reaches maturity, a load-leveling system to be installed at substations of electric utilities are expected to be commercially used. With the study on commercial application as one of the purposes, small scale (50 to 100 kW) advanced battery energy storage systems are expected to be trially employed to peak cut use at customers (prime) end. To promote introduction of the system, it is necessary to make environmental improvement in the institutional aspect. DOE

N92-22372*# Northeastern Univ., Boston, MA. Dept. of Electrical and Computer Engineering.
LABORATORY STUDY OF THE TEMPORAL EVOLUTION OF THE CURRENT-VOLTAGE CHARACTERISTIC OF A PROBE IN THE WAKE OF AN OBJECT IMMERSED IN A PULSED FLOWING PLASMA
S. Meassick and C. Chan *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 718-723 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09C

N92-22374*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ELECTROSTATIC EFFECTS ON DUST PARTICLES IN SPACE Abstract Only
Philip Leung and Ralph Wuerker *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 732 Sponsored in part by JPL, California Inst. of Technology, Pasadena (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10C

N92-22381*# Phillips Lab., Hanscom AFB, MA. Space Physics Div.
RADIATION-INDUCED INSULATOR DISCHARGE PULSES IN THE CRRES INTERNAL DISCHARGE MONITOR SATELLITE EXPERIMENT
A. R. Frederickson, E. G. Mullen, D. H. Brautigam, and K. J. Kerns *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 778-784 Prepared in cooperation with Boston Coll., Chestnut Hill, MA (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09C

N92-22441*# Naval Research Lab., Washington, DC.
ANALOG VLSI NEURAL NETWORK INTEGRATED CIRCUITS
F. J. Kub, K. K. Moon, and E. A. Just *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 147-155 Sponsored in part by ONR and Office of Naval Technology (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

N92-22442*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MONOLITHIC MICROWAVE INTEGRATED CIRCUIT WATER VAPOR RADIOMETER
L. M. Sukamto, T. W. Cooley, M. A. Janssen, and G. S. Parks *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 156-160 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

N92-22443*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Center for Space Microelectronics Technology.
A NOVEL NONCONTACTING WAVEGUIDE BACKSHORT FOR MILLIMETER AND SUBMILLIMETER WAVE FREQUENCIES
W. R. McGrath *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 161-168 Sponsored in part by Strategic Defense Initiative Organization (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

N92-22450*# Naval Ocean Systems Center, San Diego, CA.
INTEGRATED AUTOMATION FOR MANUFACTURING OF ELECTRONIC ASSEMBLIES
T. Joseph Sampite *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 235-242 Previously announced as N92-20689 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

N92-22451*# Wright Lab., Wright-Patterson AFB, OH.
THE AIR FORCE MANUFACTURING TECHNOLOGY (MANTECH): TECHNOLOGY TRANSFER METHODOLOGY AS EXEMPLIFIED BY THE RADAR TRANSMIT/RECEIVE MODULE PROGRAM
Tracy Houpt and Margaret Ridgely *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 243-246 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

N92-22453*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A VIDEO EVENT TRIGGER FOR HIGH FRAME RATE, HIGH RESOLUTION VIDEO TECHNOLOGY
Glenn L. Williams *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 254-260 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

N92-22528*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-TEMPERATURE ELECTRONICS
Lawrence G. Matus and Gary T. Seng *In its* Aeropropulsion 1987 Feb. 1990 p 233-241 (For primary document see

N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 09C

N92-22703*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PERFORMANCE OF A HIGH T (SUB c) SUPERCONDUCTING ULTRA-LOW LOSS MICROWAVE STRIPLINE FILTER
J. J. Bautista, G. Ortiz, C. Zahopoulos, S. Sridhar, and M. Lanagan (Argonne National Lab., IL.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 232-238 Previously announced as N91-32255 and A91-27959 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09C

N92-22704*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Center for Space Microelectronics Technology.
AN ADJUSTABLE RF TUNING ELEMENT FOR MICROWAVE, MILLIMETER WAVE, AND SUBMILLIMETER WAVE INTEGRATED CIRCUITS
Victor M. Lubecke, William R. McGrath, and David B. Rutledge (California Inst. of Tech., Pasadena.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 239-245 Sponsored in part by Strategic Defense Initiative Organization (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09C

N92-22958# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
ACTIVITIES OF THE ELECTRONICS GROUP [ACTIVITE DU GROUPE ELECTRONIQUE]
Jean Maignan, Jean-Luc Paillard, and Daniel Chisin *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 226-227 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-22099# Rolls-Royce Ltd., Derby (England).
THE PROBLEM OF STATIC PRESSURE MEASUREMENT IN TURBOMACHINERY ANNULI USING TRAVERSABLE INSTRUMENTATION
P. D. Smout 1 Nov. 1990 18 p
(PNR-90791; ETN-92-90844) Copyright Avail: NTIS HC/MF A03

Traverse probes are used in a component rig and engine testing to measure a range of aerodynamic quantities. Of these quantities, static pressure is the least accurately indicated towards the wall of introduction. Three particularly problematic areas in the measurement of static pressure using specifically the wedge type traverse probe are explained, the discussion drawing on the findings of several researches in addition to 'in house' experience. In view of the importance of an accurate knowledge of the static pressure field in determining turbomachine performance and efficiency levels, an experimental and theoretical study was planned. With the ultimate goal of understanding the root causes of the static pressure measurement problem, details of this study are presented, a study which it is hoped will lead to an elimination of this fundamental problem, either through reviewed calibration procedures, or through new probe designs. ESA

N92-22100# Manchester Univ. (England). Dept. of Engineering.
VORTICITY MEASUREMENTS IN THE NEAR WAKE OF A BLUFF BODY AT LOW REYNOLDS NUMBERS
R. B. Green and J. H. Gerrard Jul. 1991 27 p Sponsored by Science Research Council and Medical Research Council
(Aero-Rept-9102; ETN-92-90933) Avail: NTIS HC/MF A03

The technique of particle image velocimetry was applied to the study of bluff body wakes at low Reynolds number. Vorticity and shear stress were measured to an accuracy of 15 to 20 pct. The vortex shedding cycles at Reynolds numbers of 73 and 226 are shown and the differences between the two are highlighted. Quantitative descriptions of the previously described vortex splitting phenomenon in the near wake are made, leading to a description of the vortex shedding mechanism at low Reynolds number. A low Reynolds number formation region length is proposed. The strength of shed vortices obtained from integration of the vorticity is compared with directly measured vortex strengths. ESA

N92-22112# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Recherches Hydrauliques.
COMMUNICATION OF THE LABORATORY OF HYDRAULIC RESEARCH, NUMBER 56 [COMMUNICATION DU LABORATOIRE DE RECHERCHES HYDRAULIQUES, NO. 56]
Aug. 1991 44 p
(ETN-92-91060) Avail: NTIS HC/MF A03

Laboratory experiments on the structures of uniform flow in a smooth open channel, fully developed smooth and steady open channel flows gradually subjected to spatial acceleration, and spatially accelerating flows in a smooth open channel are reported. The influences of acceleration on the velocity and turbulence intensity profiles were investigated. Acceleration influences in the longitudinal evolution of the bottom shear stress were investigated for the spatially accelerating flows; friction velocity was investigated for the first two flows. For individual titles, see N92-22113 through N92-22115.

N92-22113# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Recherches Hydrauliques.
UNIFORM FLOW IN A SMOOTH OPEN CHANNEL
A. H. Cardoso, Walter H. Graf, and G. Gust (University of South Florida, Saint Petersburg.) *In its* Communication of the Laboratory of Hydraulic Research, Number 56 Aug. 1991 14 p Repr. from Journal of Hydraulic Research, v. 27, no. 5, 1989 p 603-616 Revised (For primary document see N92-22112 13-34)
Avail: NTIS HC/MF A03

Laboratory experiments on the structure of uniform flow in a smooth open channel are reported. Velocity profiles, turbulence intensity profiles, and friction velocity were measured. It was found that: the universal law of the wall describes rather well the data over the entire channel depth; in the core of the outer region (0.2 less than y/d less than 0.7), a wake of limited strength (pi approximately = 0.08) exists; in the near surface zone (0.7 less than y/d less than 1.0), a retarding effect, possibly due to weak secondary currents, tends to compensate the wake divergence, resulting in modified distribution of the mixing length. ESA

N92-22114# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Recherches Hydrauliques.
SPATIALLY ACCELERATING FLOW IN SMOOTH OPEN CHANNEL
A. H. Cardoso, Walter H. Graf, and G. Gust (University of South Florida, Saint Petersburg.) *In its* Communication of the Laboratory of Hydraulic Research, Number 56 Aug. 1991 8 p Presented at the 23rd International Association for Hydraulic Research Congress, Ottawa, Ontario, 21-25 Aug. 1989 Previously announced as N90-25284 (For primary document see N92-22112 13-34)
Avail: NTIS HC/MF A03

Laboratory experiments on the structure of fully developed smooth and steady open channel flows gradually subjected to spatial acceleration are reported. Mean velocity, turbulence intensity profiles, and friction velocity were measured. The following were found: self similarity is not preserved over the entire depth of the accelerated flow; a very thin universal wall layer is likely to prevail;

the turbulence intensity distribution of uniform open channel flows does not hold for the accelerated flow; the Clauser's method for the calculation of the friction velocity leads to erroneous results when applied to the velocity measurements obtained outside the mentioned thin wall layer. ESA

N92-22115# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Recherches Hydrauliques.
STEADY GRADUALLY ACCELERATING FLOW IN A SMOOTH OPEN CHANNEL
A. H. Cardoso, Walter H. Graf, and G. Gust (University of South Florida, Tampa.) *In its* Communication of the Laboratory of Hydraulic Research, Number 56 Aug. 1991 18 p Repr. from Journal of Hydraulic Research, v. 29, no. 4, 1991 p 525-543 Revised (For primary document see N92-22112 13-34)
Avail: NTIS HC/MF A03

Laboratory experiments on the structure of spatially accelerating flows in a smooth open channel are reported. The influence of acceleration on the bottom shear stress are investigated. The most important conclusions of the study are summarized as follows. The velocity distributions cannot be represented entirely by the universal log-law. However, this law seems to follow the data very close to the wall, up to about y/d less than 0.02 to approximately 0.05. Higher in the flow, the data increasingly deviate from this law. In the external layer, the equilibrium state of the flow was tested; some near equilibrium flow situations exist, but smoothly the flow was out of equilibrium. The generalization of Coles' model was tried, resulting in correlation of the wake parameter, pi, and the dimensionless pressure gradient parameter, beta, for beta less than -0.5. The acceleration of the mean velocity field leads to reduction of the turbulence intensity over the entire depth. Clauser's methods for the calculation of the friction velocity is applicable only to the measurements in the layer close to the wall (y/d less than 0.02 to approximately 0.05); Truckenbrodt's relation predicts reasonably well the friction velocity. The bottom stress intensity ratio decreases in the flow direction. ESA

N92-22116# Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. de Recherches Hydrauliques.
[ACTIVITIES REPORT OF THE LABORATORY OF HYDRAULIC RESEARCH] Annual Report, 1990 [LABORATOIRE DE RECHERCHES HYDRAULIQUES, RAPPORT ANNUEL 1990]
1990 127 p
(ETN-92-91061) Avail: NTIS HC/MF A07

The following topics are discussed: friction velocity in unsteady open-channel flow over gravel beds; nonuniform turbulent flow in rough beds flume; laboratory verification of a coupled unsteady flow model (FCM); open channel flow and turbulent measurement by high resolution Doppler sonar; and determination of turbulent mixing coefficients from Eulerian current data. For individual titles, see N92-22117 through N92-22121.

N92-22117# Ecole Polytechnique Federale de Lausanne (Switzerland).
FRICTION VELOCITY IN UNSTEADY OPEN-CHANNEL FLOW OVER GRAVEL BEDS
Haizhou Tu and Walter H. Graf *In its* Activities Report of the Laboratory of Hydraulic Research 1990 15 p (For primary document see N92-22116 13-34)
Avail: NTIS HC/MF A07

A study on friction in unsteady open channel flow over gravel beds is presented. Different hydrographs were experimentally investigated. The friction velocity was determined using the equation of motion. The unsteadiness of the flow was expressed with the dimensionless Clauser parameter. It is shown that for a given hydrograph the friction velocity is usually larger in the rising branch (accelerating flow) than in the falling branch (decelerating flow); it reaches its maximum value before the arrival of the peak of the hydrograph. During the passage of a hydrograph, the friction coefficient, f, is usually larger in the rising branch and smaller in the falling branch, the descending tendency of the f value in the rising branch is usually followed by a less pronounced ascending one in the falling branch. The findings in the friction coefficient, f, could be used to understand the field data reported in the literature. ESA

N92-22118# Ecole Polytechnique Federale de Lausanne (Switzerland).
NON-UNIFORM TURBULENT FLOW IN ROUGH BEDS FLUME
B. Kironoto and Walter H. Graf *In its* Activities Report of the Laboratory of Hydraulic Research 1990 20 p (For primary document see N92-22116 13-34)
Avail: NTIS HC/MF A07

The velocity and turbulence distributions of nonuniform flow (decelerating and accelerating flows) in rough beds flume were measured and investigated. It was found that: self similarity is preserved over the entire depth; Rotta's conditions for equilibrium flows are approximately attained; for decelerating flow, Coles' law can explain the mean velocity profiles very well over the entire depth, while for accelerating flow the validity of the law is more limited, i.e., only up to the point where the maximum velocity occurs; variation between pi and beta in open channel flow indicates a small difference with the one in pipe and in boundary layer flows; the turbulence intensities increase and decrease in decelerated and accelerated flows; as in pressure gradient boundary layer flow, the Reynolds stress distributions in open channel flow have convex forms for decelerating flow and concave ones for accelerating flow; the eddy and the mixing length distributions increase when the flow is decelerated, and decrease when it is accelerated; spectral measurements show that there is a region where the normalized energy spectral function is proportional to n exp -5/3, and the effect of pressure gradient to its distribution is practically not observed; and the macroscale and microscale values in decelerating flow are smaller than those in accelerating flow. ESA

N92-22119# Ecole Polytechnique Federale de Lausanne (Switzerland).
LABORATORY VERIFICATION OF A COUPLED UNSTEADY FLOW MODEL (FCM)
Luis R. P. Correia, Bommanna G. Krishnappan, and Walter H. Graf *In its* Activities Report of the Laboratory of Hydraulic Research 1990 8 p (For primary document see N92-22116 13-34)
Avail: NTIS HC/MF A07

For a prediction of the sediment transport and bed level changes in natural streams, the simultaneous solution of the flow continuity and momentum as well as the sediment continuity equation is needed. The model (called FCM) couples the three governing equations and is suitable to treat the sediment transport problem under unsteady flow conditions in rivers with irregular geometries. The four point implicit finite difference scheme of Preissmann is used to discretize the governing equations. The stability and convergence characteristics of this scheme are reviewed. The discretized system of algebraic equations is solved by an economic and accurate solution procedure. Emphasis on the laboratory verification of the model is given; a comparison between model predictions and flume measurements is made. Criteria for computations are proposed. ESA

N92-22120# Ecole Polytechnique Federale de Lausanne (Switzerland).
OPEN CHANNEL FLOW AND TURBULENCE MEASUREMENT BY HIGH RESOLUTION DOPPLER SONAR
R. Lhermitte (Miami Univ., FL.) and U. Lemmin *In its* Activities Report of the Laboratory of Hydraulic Research 1990 39 p Sponsored in part by Swiss Front National for Research (For primary document see N92-22116 13-34)
Avail: NTIS HC/MF A07

Measurements of water motion and turbulence performed using a specially designed, multibeam, pulse to pulse coherent Doppler sonar operating at a 1 MHz frequency and installed in a water flume are presented. These results show that the instrument is a useful tool for nonintrusive and accurate measurements of vertical profiles of water horizontal velocity, u, and vertical velocity, w, as

well as water turbulence parameters associated with a fully developed boundary layer in the water flume. The water circulating in the flume is well filtered so that it is free of particulates and gas bubbles. The acoustic wave backscattering must be due to temperature gradient, dT/dx, structures occurring at a k sub so = 2/lambda wavenumber (lambda is the sonar wavelength). The backscattering intensity is related to the spectral density observed at that wavenumber in the dT/dx spectrum which in turn can be derived from the Batchelor temperature spectrum. Quantitative water backscattering measurements, conducted with the calibrated Doppler sonar at different turbulence intensities, provided data supporting the Batchelor spectrum considerations above, revealing the existence of a backscattering threshold occurring at k sub t. These results can be scaled to predict acoustic wave backscattering by oceanic turbulence. ESA

N92-22121# Ecole Polytechnique Federale de Lausanne (Switzerland).
ON THE DETERMINATION OF TURBULENT MIXING COEFFICIENTS FROM EULERIAN CURRENT DATA
U. Lemmin, Z. Vescernyes, and Walter H. Graf *In its* Activities Report of the Laboratory of Hydraulic Research 1990 26 p (For primary document see N92-22116 13-34)
Avail: NTIS HC/MF A07

Based upon Eulerian current measurements an investigation of turbulent mixing dynamics in Lake Geneva (Switzerland) was carried out. High frequency current fluctuation components were determined by filtering the synoptic data. By means of a sensitivity analysis, the filtered data were investigated. Their turbulence characteristics related to the selected frequency ranges was considered. Stationary, isotropic turbulence is found to be limited to time scales being less than 0.5 d. The average mixing coefficients, A sub H when limited to timescales being less than 0.5 d show little difference between each other. They are one to two orders of magnitude below estimates from the Laurentian Great Lakes (North America) and the ocean. The time variation of the mixing coefficients, being three orders of magnitude, is explained by the dominant effect of wind forcing. ESA

N92-22136 Texas Univ., Arlington.
DEVELOPMENT OF A 3-D UNSTRUCTURED CFD METHOD Ph.D. Thesis
Steve Louis Karman, Jr. 1991 168 p
Avail: Univ. Microfilms Order No. DA9131749

A computational fluid dynamics (CFD) program is developed for analyzing complex configurations and flowfields. The program uses unstructured grid methods in a finite volume formulation to solve the compressible Navier-Stokes equations. A two equation turbulence model is included. An upwind differencing scheme is employed for computing the inviscid fluxes, while central differencing is used for the viscous fluxes. The grid can be dynamically moved to adapt to flowfield gradients or track the motion of moving boundaries. The motion of the grid is accurately modeled through the grid speed metrics. Thus, time accurate unsteady analyses can be performed. The ability to add or delete points from the grid also exists. Thus, initial meshes can be enhanced to better solve the flowfield features. Several two dimensional axisymmetric and three dimensional cases are included to demonstrate the different capabilities of the program.
Dissert. Abstr.

N92-22140# Maryland Univ., College Park. Inst. for Physical Science and Technology.
NUMERICAL SOLUTION OF CONVECTION DIFFUSION EQUATION Final Report, May 1988 - Jun. 1991
R. B. Kellogg 15 Aug. 1991 3 p
(Contract DAAL03-88-K-0081)
(AD-A244563; ARO-25395.6-MA) Avail: NTIS HC/MF A01
CSCL 20/4

The bibliographies of papers published in the area of numerical solutions of the convection-diffusion equation are listed. Additionally, the following topics are presented: flow directed iterative methods; numerical solution of parabolic problems with interior layers; viscous compressible flow; and corners in singular perturbation problems. GRA

N92-22152 Heriot-Watt Univ., Edinburgh (Scotland).
A PIV STUDY OF THE 3-D FLOW BEHIND A CIRCULAR CYLINDER Ph.D. Thesis
Shouping Dong 1990 308 p
Avail: Univ. Microfilms Order No. BRDX94554

The three-dimensional aspects of a flowfield behind a circular cylinder are investigated using both conventional experimental techniques and a new optical method, Particle Image Velocimetry (PIV). The first part consists of an experimental investigation using pressure transducers and dye along with a theoretical model. Some important three-dimensional characteristics of the flowfield behind a circular cylinder are identified. The second part develops the application of the PIV to the investigation of the three-dimensional flowfield behind a circular cylinder. For this purpose two schemes, namely laser sheet scanning and bi-laser sheet illumination, are proposed and developed. The digital image processing technique required to analyze the photographic negatives is described. Particular importance is placed on the filtering of the image, particle matching algorithms, and the technique of two-dimensional spatial correlation analysis. Dissert. Abstr.

N92-22200 Liverpool Univ. (England).
BOUNDARY LAYER TRANSITION ON CONCAVE SURFACES Ph.D. Thesis
Farouk H. Hachem 1989 294 p
Avail: Univ. Microfilms Order No. BRDX94041

Using a hot wire anemometer system, the laminar development and transition of a boundary layer on a concave surface was studied. The start and end of transition results were obtained using an algorithm for determining the intermittency factor which did not require calibration. Measurements were done at free stream turbulence levels of 0.7 percent and 2.6 percent. Three flow visualization techniques were employed to show the formation and development of Taylor Gortler vortices and to identify the transition position on the concave surface. The boundary layer profile was observed to be highly distorted by the momentum transfer associated with the vortices. This distortion has the effect of increasing the boundary layer growth rate and modifying the start of transition momentum thickness Reynolds numbers from the typical value of the flat plate. For modest curvatures, the vortices carry turbulence towards the blade which promises transition, but as the curvature is increased further, the boundary layer profile shape is stabilized and transition is delayed. A model for the distorted boundary layer is presented and is used to predict the boundary layer growth rate and correlate the start of transition results in terms of the momentum thickness and blade radius Reynolds number and the free stream turbulence level.
Dissert. Abstr.

N92-22204 Ohio State Univ., Columbus.
ON THE NUMERICAL SOLUTION OF INCOMPRESSIBLE THREE-DIMENSIONAL NAVIER-STOKES EQUATIONS Ph.D. Thesis
V. Babu 1991 156 p
Avail: Univ. Microfilms Order No. DA9201615

Numerical methods for the solution of the incompressible, 3-D Navier-Stokes equations in primitive variable form on uniform and nonuniform grids are developed. The Neumann-Poisson problem for pressure that arises in this formulation requires an integral constraint to be satisfied during every time step of the time marching procedure. A consistent finite differencing method proposed earlier by Abdallah that allows this constraint to be satisfied to a machine accuracy is used for studying thermocapillary convection in a cubical cavity. Problems with this method led to the use of the method of matrix decomposition for the solution of the pressure problem. This method yields machine accurate solutions to the Neumann-Poisson problem at computing speeds around 310 Mflops on the Cray Y-MP8/864. Extension of this method to nonuniform grids is also discussed. Using this method

for solving the pressure, solutions to the 3-D lid driven cavity problem on grids as large as 80 x 80 x 80 are presented. Stability restrictions on the time differencing scheme used for all these calculations, namely, the explicit scheme, necessitate the use of methods that are unconditionally stable, to reduce the overall computing time. Dissert. Abstr.

N92-22209# Cambridge Univ. (England). Dept. of Engineering.
SEPARATION OF RELAMINARISED BOUNDARY LAYERS
Rune Brandt and M. Gaster Oct. 1991 104 p
(CUED/A-Aero/TR-16; ISBN-0309-7293; RAE-2029/236) Avail: NTIS HC/MF A06

A series of experiments have been performed using a new experimental rig. This rig is capable of producing accelerations and decelerations of a boundary layer on a flat plate. The boundary layer developed initially in a zero pressure gradient was subjected to pressure gradients similar to those observed on leading edges of wings at high angles of attack. The data obtained will be useful for validating methods for predicting such flows. Among the tests performed are: varying the initial momentum-thickness Reynolds number; skin friction measurements; velocity and turbulence intensity profiles; and flow separation and reattachment. H.A.

N92-22226*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ULTRA-SHARP SOLUTION OF THE SMITH-HUTTON PROBLEM
B. P. Leonard and Simin Mokhtari (Akron Univ., OH.) Feb. 1992 40 p
(NASA Order C-99066-G)
(NASA-TM-105435; ICOMP-92-03; E-6393; NAS 1.15:105435) Avail: NTIS HC/MF A03 CSCL 20D

Highly convective scalar transport involving near-discontinuities and strong streamline curvature was addressed in a paper by Smith and Hutton in 1982, comparing several different convection schemes applied to a specially devised test problem. First order methods showed significant artificial diffusion, whereas higher order methods gave less smearing but had a tendency to overshoot and oscillate. Perhaps because unphysical oscillations are more obvious than unphysical smearing, the intervening period has seen a rise in popularity of low order artificially diffusive schemes, especially in the numerical heat transfer industry. The present paper describes an alternate strategy of using non-artificially diffusive high order methods, while maintaining strictly monotonic transitions through the use of simple flux limited constraints. Limited third order upwinding is usually found to be the most cost effective basic convection scheme. Tighter resolution of discontinuities can be obtained at little additional cost by using automatic adaptive stencil expansion to higher order in local regions, as needed. Author

N92-22228*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
NUMERICAL SIMULATION OF TRANSIENT HYPERVELOCITY FLOW IN AN EXPANSION TUBE Final Report
P. A. Jacobs Mar. 1992 49 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189615; NAS 1.26:189615; ICASE-92-10) Avail: NTIS HC/MF A03 CSCL 20D

Several numerical simulations of the transient flow of helium in an expansion tube are presented in an effort to identify some of the basic mechanisms which cause the noisy test flows seen in experiments. The calculations were performed with an axisymmetric Navier-Stokes code based on a finite volume formulation and upwinding techniques. Although laminar flow and ideal bursting of the diaphragms was assumed, the simulations showed some of the important features seen in experiments. In particular, the discontinuity in tube diameter of the primary diaphragm station introduced a transverse perturbation to the expanding driver gas and this perturbation was seen to propagate into the test gas under some flow conditions. The disturbances seen in the test flow can be characterized as either small amplitude, low frequency noise possibly introduced during shock compression or large amplitude, high frequency noise associated with the passage of the reflected head of the unsteady expansion. Author

N92-22266*# Arizona State Univ., Tempe.
A NEAR-WALL FOUR-EQUATION TURBULENCE MODEL FOR COMPRESSIBLE BOUNDARY LAYERS
T. P. Sommer, R. M. C. So, and H. S. Zhang Washington NASA Apr. 1992 50 p
(Grant NAG1-1080)
(NASA-CR-4436; NAS 1.26:4436) Avail: NTIS HC/MF A03 CSCL 20D

A near-wall four-equation turbulence model is developed for the calculation of high-speed compressible turbulent boundary layers. The four equations used are the k-epsilon equations and the theta(exp 2)-epsilon(sub theta) equations. These equations are used to define the turbulent diffusivities for momentum and heat fluxes, thus allowing the assumption of dynamic similarity between momentum and heat transport to be relaxed. The Favre-averaged equations of motion are solved in conjunction with the four transport equations. Calculations are compared with measurements and with another model's predictions where the assumption of the constant turbulent Prandtl number is invoked. Compressible flat plate turbulent boundary layers with both adiabatic and constant temperature wall boundary conditions are considered. Results for the range of low Mach numbers and temperature ratios investigated are essentially the same as those obtained using an identical near-wall k-epsilon model. In general, the numerical predictions are in very good agreement with measurements and there are significant improvements in the predictions of mean flow properties at high Mach numbers. Author

N92-22398*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A KAPPA-EPSILON CALCULATION OF TRANSITIONAL BOUNDARY LAYERS
Z. Yang and T. H. Shih Mar. 1992 12 p
(NASA Order C-99066-G)
(NASA-TM-105604; ICOMP-92-08; CMOTT-92-05; E-6939; NAS 1.15:105604) Avail: NTIS HC/MF A03 CSCL 20D

A recently proposed kappa-epsilon model for low Reynolds number turbulent flows was modified by introducing a new damping function f(sub mu). The modified model is used to calculate the transitional boundary layer over a flat plate with different freestream turbulence levels. It is found that the model could mimic the transitional flow. However, the predicted transition is found to be sensitive to the initial conditions. Author

N92-22487*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A PRELIMINARY CHARACTERIZATION OF THE TENSILE AND FATIGUE BEHAVIOR OF TUNGSTEN-FIBER/WASPALOY-MATRIX COMPOSITE
Ralph E. Corner and Brad A. Lerch Jan. 1992 17 p
(NASA-TM-105346; E-6716; NAS 1.15:105346) Avail: NTIS HC/MF A03 CSCL 20D

A microstructural study and a preliminary characterization of the room temperature tensile and fatigue behavior of a continuous, tungsten fiber, Waspaloy-matrix composite was conducted. A heat treatment was chosen that would allow visibility of planar slip if it occurred during deformation, but would not allow growth of the reaction zone. Tensile and fatigue tests showed that the failed specimens contained transverse cracks in the fibers. The cracks that occurred in the tensile specimen were observed at the fracture surface and up to approximately 4.0 mm below the fracture surface. The crack spacing remained constant along the entire length of the cracked fibers. Conversely, the cracks that occurred in the fatigue specimen were only observed in the vicinity of the fracture surface. In instances where two fiber cracks occurred in the same plane, the matrix often necked between the two cracked fibers. Large groups of slip bands were generated in the matrix near the fiber cracks. Slip bands in the matrix of the tensile specimen were also observed in areas where there were no fiber cracks, at

distances greater than 4 mm from the fracture surface. This suggests that the matrix plastically flows before fiber cracking occurs. Author

N92-22491*# Akron Univ., OH. Dept. of Electrical Engineering.
IMPROVED LARGE PERTURBATION PROPULSION MODELS FOR CONTROL SYSTEM DESIGN (1988-1989) AND LARGE PERTURBATION MODELS OF HIGH VELOCITY PROPULSION SYSTEMS (1989-1990) AND REDUCED ORDER PROPULSION MODELS FOR CONTROL SYSTEM DESIGN (1990-1991) Final Report
Tom T. Hartley and J. Alex DeAbreu-Garcia Dec. 1991 84 p
(Grant NAG3-904)
(NASA-CR-190148; NAS 1.26:190148) Avail: NTIS HC/MF A05 CSCL 20D

Methods for modeling high speed propulsion systems will be discussed. Included in this category are internal flow propulsion systems without rotating machinery, such as inlets, ramjets, and scramjets. Among the modeling topics discussed are modeling of linear isentropic flow, heat exchange, gasdynamics, lumped parameter systems, and infinite dimensional systems. Furthermore, a generalized overview of modeling high speed propulsion systems is presented in this collection of papers. For individual titles, see N92-22492 through N92-22498.

N92-22492*# Akron Univ., OH.
A HIERARCHY FOR MODELING HIGH SPEED PROPULSION SYSTEMS c07
Tom T. Hartley and Alex DeAbreu *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 p 1-20 Previously announced as N92-19934 (For primary document see N92-22491 13-34)
(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 21E

General research efforts on reduced order propulsion models for control systems design are overviewed. Methods for modeling high speed propulsion systems are discussed including internal flow propulsion systems that do not contain rotating machinery such as inlets, ramjets, and scramjets. The discussion is separated into four sections: (1) computational fluid dynamics model for the entire nonlinear system or high order nonlinear models; (2) high order linearized model derived from fundamental physics; (3) low order linear models obtained from other high order models; and (4) low order nonlinear models. Included are special considerations on any relevant control system designs. The methods discussed are for the quasi-one dimensional Euler equations of gasdynamic flow. The essential nonlinear features represented are large amplitude nonlinear waves, moving normal shocks, hammershocks, subsonic combustion via heat addition, temperature dependent gases, detonation, and thermal choking. H.A.

N92-22493*# Akron Univ., OH. Dept. of Electrical Engineering
APPROXIMATE TRUNCATED BALANCED REALIZATIONS FOR INFINITE DIMENSIONAL SYSTEMS c64
Tom T. Hartley and J. Alex DeAbreu-Garcia *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 14 p (For primary document see N92-22491 13-34)
(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 12A

This paper presents an approximate method for obtaining truncated balance realizations of systems represented by non-rational transfer functions, that is infinite dimensional systems. It is based on the approximation to the Hankel operator. Author

N92-22494*# Akron Univ., OH. Dept. of Electrical Engineering.
PHYSICAL LUMPING METHODS FOR DEVELOPING LINEAR REDUCED MODELS FOR HIGH SPEED PROPULSION SYSTEMS
S. M. Immel, Tom T. Hartley, and J. Alex DeAbreu-Garcia *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 12 p (For primary document see N92-22491 13-34)
Avail: NTIS HC/MF A05 CSCL 20D

In gasdynamic systems, information travels in one direction for supersonic flow and in both directions for subsonic flow. A shock occurs at the transition from supersonic to subsonic flow. Thus, to simulate these systems, any simulation method implemented for the quasi-one-dimensional Euler equations must have the ability to capture the shock. In this paper, a technique combining both backward and central differencing is presented. The equations are subsequently linearized about an operating point and formulated into a linear state space model. After proper implementation of the boundary conditions, the model order is reduced from 123 to less than 10 using the Schur method of balancing. Simulations comparing frequency and step response of the reduced order model and the original system models are presented. Author

N92-22495*# Akron Univ., OH. Dept. of Electrical Engineering.
MODELING OF LINEAR ISENTROPIC FLOW SYSTEMS
Athan D. Sarantopoulos and Tom T. Hartley *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 4 p (For primary document see N92-22491 13-34)
(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 20D

A modeling approach for linear isentropic flow systems based on the quasi-one-dimensional Euler equations of non-viscous, compressible flow are presented. Such systems are representative of certain high speed propulsion systems. Accurate models useful in control system studies are developed. A supersonic inlet is considered, and the resulting set of partial differential equations with boundary conditions is solved for a linear transfer matrix using Laplace transforms. Author

N92-22496*# Akron Univ., OH. Dept. of Electrical Engineering.
MODELLING AND SIMULATION OF A HEAT EXCHANGER
Lei Xia, J. Alex DeAbreu-Garcia, and Tom T. Hartley *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 7 p (For primary document see N92-22491 13-34)
(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 20D

Two models for two different control systems are developed for a parallel heat exchanger. First by spatially lumping a heat exchanger model, a good approximate model which has a high system order is produced. Model reduction techniques are applied to these to obtain low order models that are suitable for dynamic analysis and control design. The simulation method is discussed to ensure a valid simulation result. Author

N92-22497*# Akron Univ., OH. Dept. of Electrical Engineering.
TEMPERATURE CONTROL IN CONTINUOUS FURNACE BY STRUCTURAL DIAGRAM METHOD
Xia Lei and Tom T. Hartley *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion M odels for Control System Design (1990-1991) Dec. 1991 3 p Previously announced in IAA as A92-29162 (For primary document see N92-22491 13-34)

(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 20D

The fundamentals of the structural diagram method for distributed parameter systems (DPSs) are presented and reviewed. An example is given to illustrate the application of this method for control design. Author

N92-22498*# Akron Univ., OH. Dept. of Electrical Engineering.
A SIMPLE METHOD FOR SIMULATING GASDYNAMIC SYSTEMS
Tom T. Hartley *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 22 p (For primary document see N92-22491 13-34)
Avail: NTIS HC/MF A05 CSCL 20D

A simple method for performing digital simulation of gasdynamic systems is presented. The approach is somewhat intuitive, and requires some knowledge of the physics of the problem as well as an understanding of the finite difference theory. The method is explicitly shown in appendix A which is taken from the book by P.J. Roache, 'Computational Fluid Dynamics,' Hermosa Publishers, 1982. The resulting method is relatively fast while it sacrifices some accuracy. H.A.

N92-22662*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
METHODOLOGY FOR SENSITIVITY ANALYSIS, APPROXIMATE ANALYSIS, AND DESIGN OPTIMIZATION IN CFD FOR MULTIDISCIPLINARY APPLICATIONS Progress Report, 15 Apr. 1991 - 14 Apr. 1992
Arthur C. Taylor, III and Gene W. Hou Apr. 1992 70 p
(Grant NAG1-1265)
(NASA-CR-190201; NAS 1.26:190201) Avail: NTIS HC/MF A04 CSCL 20D

Fundamental equations of aerodynamic sensitivity analysis and approximate analysis for the two dimensional thin layer Navier-Stokes equations are reviewed, and special boundary condition considerations necessary to apply these equations to isolated lifting airfoils on 'C' and 'O' meshes are discussed in detail. An efficient strategy which is based on the finite element method and an elastic membrane representation of the computational domain is successfully tested, which circumvents the costly 'brute force' method of obtaining grid sensitivity derivatives, and is also useful in mesh regeneration. The issue of turbulence modeling is addressed in a preliminary study. Aerodynamic shape sensitivity derivatives are efficiently calculated, and their accuracy is validated on two viscous test problems, including: (1) internal flow through a double throat nozzle, and (2) external flow over a NACA 4-digit airfoil. An automated aerodynamic design optimization strategy is outlined which includes the use of a design optimization program, an aerodynamic flow analysis code, an aerodynamic sensitivity and approximate analysis code, and a mesh regeneration and grid sensitivity analysis code. Application of the optimization methodology to the two test problems in each case resulted in a new design having a significantly improved performance in the aerodynamic response of interest. Author

N92-22788# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
NUCLEATION OF VORTICES AT THE A-B PHASE BOUNDARY IN SUPERFLUID He-3: NONCONSERVATION OF CIRCULATION AND VORTICES WITH SOLITON TAILS IN THE B PHASE
Y. Kondo, M. Krusius, E. V. Thuneberg, J. S. Korhonen, and V. V. Dmitriev 9 May 1991 18 p Prepared in cooperation with Academy of Sciences (USSR), Moscow
(PB92-134170; TKK-F-A688; ISBN-951-22-0649-8) Avail: NTIS HC/MF A03 CSCL 20D

The reversible A reversible to B phase transitions under rotation was studied with nuclear magnetic resonance techniques. The A yields B transition gives rise to a B phase state which contains: (1) only half of the equilibrium number of vortices; and (2) theta solitons attached to combined vortex disclination lines. The B yields A transition leads to the usual equilibrium state of continuous vortices. The observations support the hypothesis that only one half of a doubly quantized A phase vortex transforms to a singular B phase vortex at the A-B interface. Author

N92-23120# Oak Ridge National Lab., TN.
HEAT PUMP SYSTEMS WITH DIRECT EXPANSION GROUND COILS
O. J. Svec and V. D. Baxter 1991 22 p Presented at the 4th Conference and Equipment Show: Meeting Customers Needs With Heat Pumps, Dallas, TX, 15-18 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-007831; CONF-911080-1) Avail: NTIS HC/MF A03

This paper is a summary of an International research project organized within the framework of the International Energy Agency (IEA), Implementing Agreement on Heat Pumps. This cooperative project, based on a task sharing principle, was proposed by the Canadian team and joined by the national teams of the United States of America, Japan and Austria. The Institute for Research in Construction (IRC) of the National Research Council of Canada (NRCC), has been acting as the Operating Agent for this project, known as Annex XV. The need for this research work is based on the recognition of the state-of-the-art of Ground Source Heat Pump (GSHP) technology, which can simply be described by the following two statements: (1) GSHP technology is the most successful among all renewable technologies in North American and northern European countries; and (2) installation cost of GSHP systems is currently too high for a meaningful worldwide penetration into the heating/cooling market. DOE

N92-22438*# Sterling Federal Systems, Inc., Palo Alto, CA.
FAST: A MULTI-PROCESSED ENVIRONMENT FOR VISUALIZATION OF COMPUTATIONAL FLUID DYNAMICS
Gordon V. Bancroft, Fergus J. Merritt, Todd C. Plessel, Paul G. Kelaita, and R. Kevin McCabe *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 118-127 (For primary document see N92-22423 13-99)
(Contract NAS2-13210)
Avail: NTIS HC/MF A23 CSCL 20D

N92-22522*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTRODUCTION TO THE INTERNAL FLUID MECHANICS RESEARCH SESSION Abstract Only
Brent A. Miller and Louis A. Povinelli *In its* Aeropropulsion 1987 Feb. 1990 p 155 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

N92-22523*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INLETS, DUCTS, AND NOZZLES
John M. Abbott, Bernhard H. Anderson, and Edward J. Rice *In its* Aeropropulsion 1987 Feb. 1990 p 157-174 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

N92-22525*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CHEMICAL REACTING FLOWS
Edward J. Mularz (Army Aviation Systems Command, Cleveland, OH.) and Peter M. Sockol *In its* Aeropropulsion 1987 Feb. 1990 p 197-208 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

N92-22542*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH-SPEED INLET RESEARCH PROGRAM AND SUPPORTING ANALYSIS

Robert E. Coltrin *In its* Aeropropulsion 1987 Feb. 1990 p 469-486 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20D

N92-23076# Groningen Rijksuniv. (Netherlands). Dept. of Chemical Engineering.
MARANGONI CONVECTION DUE TO EVAPORATION
L. P. B. M. Janssen and H. C. J. Hoefsloot *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 137-139 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N92-22165 Pennsylvania State Univ., University Park.
APPLICATION OF PHOTOREFRACTIVE HOLOGRAMS TO OPTICAL SIGNAL PROCESSING Ph.D. Thesis
Shudong Wu 1991 143 p
Avail: Univ. Microfilms Order No. DA9204320

Holography is considered to be an important technique in optical signal processing. The application of photorefractive holograms to reconfigurable optical interconnections, real-time correlators, and fiber specklegrams is studied. Two schemes for reconfigurable optical interconnections, i.e., wavelength tuning and spatial division, are proposed. With the finite wavelength tunability of laser diodes, reflection type volume holograms can be used for a large number of reconfigurable interconnections. Transmission volume holograms encoded in the form of pinhole holograms can be easily reconfigured by a spatial light modulator. An analysis of the wavelength selectivity, the angular selectivity, the storage capacity, as well as the experimental demonstrations, are given. Fiber specklegrams are holograms formed by interfering the output speckle field from a multimode fiber with a reference beam, and read out by the speckle field. The reconstruction of the reference beam is highly sensitive to the output modal phases of the fiber. Also, it is less vulnerable to environmental factors. Analyses indicate that the fiber specklegram possesses a very narrow spectral response bandwidth. Dissert. Abstr.

N92-22239*# Pratt and Whitney Aircraft, East Hartford, CT. Commercial Engine Business.
HIGH TEMPERATURE STRAIN GAGE TECHNOLOGY FOR HYPERSONIC AIRCRAFT DEVELOPMENT APPLICATIONS
W. L. Anderson and H. P. Grant Feb. 1992 54 p
(Contract NAS3-25410)
(NASA-CR-189101; NAS 1.26:189101; PWA-6141) Avail: NTIS HC/MF A04 CSCL 14B

An experimental evaluation of Pd 13 percent Cr and of BCL-3 alloy wire strain gages was conducted on IN100 and Cu 0.15 percent Zr alloy substrates. Testing included apparent strain, drift, gage factor, and creep. Maximum test temperature was 1144 K (1600 F). The PdCr gages incorporated Pt temperature compensation elements. The PdCr gages were found to have good resistance stability below 866 K (1100 F). The BCL 3 gages were found to have good resistance stability above 800 K (981 F), but high drift around 700 K (800 F). Author

N92-22399# National Aeronautical Lab., Bangalore (India).
DEVELOPMENT OF TRANSDUCERS FOR AEROSPACE STRUCTURE TESTING USING PIEZOELECTRIC CERAMIC/POLYMER. PART1: FABRICATION OF ACCELEROMETER USING PIEZOELECTRIC CERAMIC
K. Bandyopadhyay Dec. 1991 29 p
(NAL-PD-MT-9126) Avail: NTIS HC/MF A03

A feasibility study of using piezoelectric ceramic for development of transducers for aerospace structure testing is presented. The two types of piezoelectric seismic accelerometers, compression and bender, were designed and fabricated. The accelerometers utilize piezoelectric ceramic lead zirconate titanate/lead lanthanum zirconate titanate (PZT/PLZT) as transducing material. Author

N92-22405*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF A CONTACT LENS QUALITY MONITORING SYSTEM
Jag J. Singh, Chih-Ping Shen (Old Dominion Univ., Norfolk, VA.), and Danny R. Sprinkle Apr. 1992 17 p
(NASA-TM-104227; NAS 1.15:104227) Avail: NTIS HC/MF A03 CSCL 14B

The quality of contact lens samples depends strongly on their free volume fractions. It is expected that the free volume fraction of the test samples will also impact their attenuation coefficients for soft x rays. Samples with larger free volume fractions should have lower linear attenuation coefficients. Linear attenuation coefficients for Cd-109/Ag-109 x rays have been measured in five contact lens samples. It has been shown that the difference in the linear attenuation coefficients of discs from any given sample are entirely due to the difference in their respective volume fractions. It is therefore concluded that an x ray attenuation measurement system can serve as a quality monitor for contact lens polymers. Author

N92-22490*# MetroLaser, Irvine, CA.
HOLOGRAPHIC FLOW DIAGNOSTICS FOR THE SPACE SHUTTLE MAIN ENGINE Final Report
Feb. 1992 12 p
(Contract NAS8-38608)
(NASA-CR-184320; NAS 1:26:184320) Avail: NTIS HC/MF A03 CSCL 14E

Summarized here are the results of an effort to produce holograms of the exhaust from the Space Shuttle Main Engine (SSME) being tested on a test stand at the Marshall Space Flight Center (MSFC). The effort took place from December 1990 to January 1992, during which seven trips were made from MetroLaser to MSFC. A brief outline of each trip is given. Due to the suspension of the SSME program in Huntsville and unexpected complications in resolving safety issues, the proposed holography system was not operated until November 1991. A NASA 100 mW Argon laser was installed in the holography system for an October engine test while these safety issues were being resolved. A video camera shadowgraph was made during this test, which was shut down prematurely after 20 seconds. System problems precluded successful operation of the holography system until the January 1992 engine test. No hologram resulted during this test due to heavy fog conditions around the engine. Author

N92-22641# European Space Agency, Paris (France).
INVESTIGATION OF THE DYNAMIC BEHAVIOUR AND THE FREQUENCY RESPONSE OF THE GG 1342 LASER GYRO
Helmut Niederstrasser (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) Nov. 1991 100 p Transl. into ENGLISH of Untersuchung des Dynamischen Verhaltens und Vermessung der Uebertragungsfunktion des Laserkreisels GG 1342 (Brunswick, Fed. Republic of Germany, DLR), Jan. 1990 95 p Original language document was announced as N91-12070
(ESA-TT-1236; DLR-FB-90-22; ETN-92-91206) Avail: NTIS HC/MF A05

The dynamic behavior of a laser gyro under conditions of angular vibrations and constant rates of rotation is investigated on a single axis turntable. It is demonstrated that a laser gyro for inertial navigation also meets flight control requirements. The gyro behavior is represented by power density spectra of its measured rate of rotation and by its transfer function. A measuring system consisting of inductosyn, tachometer, and linear accelerometer serves as

hybrid rotational speed reference. The characteristics of the gyro rate measurements, for example the measurement noise and the other reaction motion, are discussed. ESA

N92-22786# Physical Optics Corp., Torrance, CA.
LOW COST POROUS FIBER OPTIC MULTI-GAS SENSORS FOR COMBUSTION CONTROL SYSTEMS. PART 1: FIBER OPTIC SENSOR FEASIBILITY ANALYSIS Topical Report, Nov. 1990 - May 1991
E. M. Schmidlin 31 May 1991 79 p
(Contract GRI-5090-298-2081)
(PB92-132943; GRI-91/0194-Pt-1) Avail: NTIS HC/MF A05 CSCL 14B

The objective was to develop an improved gas sensor system for accurate 'on-line' monitoring of combustion species aimed to improve the efficiency of gas fired combustion systems. Phase 1 of the program was the feasibility analysis of the proposed fiber optic multi-gas sensor. The analysis included: (1) a comprehensive literature search of research being performed in the areas of combustion diagnostics and fiber optic sensors; (2) a gas sensor vendor survey to evaluate the potential use of commercially available gas sensors for 'on-line' stack gas analysis; and (3) an optical fiber evaluation, including temperature testing of selected fiber samples and evaluation of fiber optic materials which are currently under development. Phase 2 of the program will entail fabrication and testing of the proof-of-concept fiber optic sensor system. Author

N92-22439*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A NEAR-REAL-TIME FULL-PARALLAX HOLOGRAPHIC DISPLAY FOR REMOTE OPERATIONS
Helene P. Iavecchia, Lloyd Huff (Dayton Univ. Research Inst., OH.), and Neville I. Marzwell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 128-136 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

N92-22452*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GALLIUM ARSENIDE QUANTUM WELL-BASED FAR INFRARED ARRAY RADIOMETRIC IMAGER
Kathrine A. Forrest and Murzy D. Jhabvala *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 249-253 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 14B

N92-22454*# TeleRobotics International, Inc., Knoxville, TN.
AN ELECTRONIC PAN/TILT/ZOOM CAMERA SYSTEM
Steve Zimmermann and H. Lee Martin *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 261-270 (For primary document see N92-22423 13-99)
(Contract NAS1-18855)
Avail: NTIS HC/MF A23 CSCL 14E

N92-22526*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RESEARCH SENSORS
David R. Englund *In its* Aeropropulsion 1987 Feb. 1990 p 217-224 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 14B

N92-22527*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPTICAL MEASUREMENT SYSTEMS
Daniel J. Lesco *In its* Aeropropulsion 1987 Feb. 1990 p 225-232 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 14B

N92-22721*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AMBIENT TEMPERATURE RECORDER
Larry D. Russell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 407-414 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14B

N92-22723*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COMMERCIAL CAPACIFLECTOR
John M. Vranish *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 423-434 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14B

N92-22725*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
REMOTE SEMI-CONTINUOUS FLOW RATE LOGGING SEEPAGE METER
William G. Reay (Virginia Polytechnic Inst. and State Univ., Blacksburg.) and Harry G. Walthall *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 445-451 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14B

N92-22815# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Optoelectronics.
COMPACT LASER DOPPLER ANEMOMETER
Ch. Werner, M. Klier, H. Herrmann, E. Biselli, and R. Haering *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 7 p (For primary document see N92-22790 13-46)
Copyright Avail: NTIS HC/MF A15; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-22954# Paris-Sud Univ., Orsay (France).
MULTISLOT CCD CAMERA FOR THREE DIMENSIONAL X IMAGING OF LASER PLASMAS: INSERTION IN A 6 BEAM CHAMBER AND RESULTS [CAMERA MULTIFENTES A CCD POUR L'IMAGERIE X TRI-DIMENSIONNELLE DE PLASMAS LASER: IMPLANTATION DANS L'ENCEINTE 6 FAISCEAUX ET RESULTATS]
N. deBeaucoudrey, A. Bellemain, D. Phalippou, Jean-Michel Boudenne, Michel Koenig, and Alain Michard (Ecole Polytechnique, Palaiseau, France) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 205-210 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22955# Ecole Polytechnique, Palaiseau (France). Lab. de Physique des Milieux Ionises.
SPATIAL AND TEMPORAL RESOLUTION SPECTROSCOPY [SPECTROGRAPHIE A RESOLUTION SPATIALE ET TEMPORELLE]
Christina A. Back, Claude Chenais-Popovics, and Jean-Claude Gauthier *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 213-217 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22956# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
ADAPTING A NEW SCANNING SLOT CAMERA FOR OPTICAL X ULTRAVIOLET GLANCING INCIDENCE [ADAPTATION D'UNE NOUVELLE CAMERA A BALAYAGE DE FENTE POUR L'OPTIQUE X-UV SOUS INCIDENCE RASANTE]
Antoine Carillon, Gerard Jamelot, and Pierre Jaegle *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 218-222 In FRENCH (For primary document

see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22957# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
EXPERIMENTAL TECHNICAL GROUP [GROUPE TECHNIQUE EXPERIMENTAL]
Jean-Michel Boudenne, Pascal Godeau, Raymond Konig, Patrick Legriel, Alain Michard, and Henri Timsit *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 223-225 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-23079# National Aerospace Lab., Amsterdam (Netherlands).
INSTRUMENT DEVELOPMENT FOR THE WET SATELLITE MODEL EXPERIMENT
J. P. B. Vreeburg *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 142-144 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23081# Technische Univ., Delft (Netherlands). Center for Submicron Technology.
NANOMETER-SCALE LITHOGRAPHY FOR LARGE LATERAL STRUCTURES
Johannes Romijn and E. vanderDrift *In its* Metallic Structures with Reduced Dimensions 1991 p 11-26 Repr. from Physica B, v. 152, 1988 p 14 Presented at NATO Advanced Research Workshop on Coherence in Superconducting Networks, Delft, Netherlands (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

N92-23082# Technische Univ., Delft (Netherlands). Centre for Submicron Technology.
TUNGSTEN CALIBRATION MARKERS FOR ELECTRON BEAM PATTERN GENERATORS
D. A. vanLeeuwen, R. J. M. vanVucht (Nederlandse Philips Bedrijven B.V., Eindhoven.), Johannes Romijn, and E. vanderDrift *In its* Metallic Structures with Reduced Dimensions 1991 p 27-36 Repr. from Proceedings Micro Circuit Engineering Conference 1988 (Amsterdam, Netherlands, North Holland Publishing), 1989 p 247 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

N92-23083# Technische Univ., Delft (Netherlands). Inst. for Microelectronics and Submicron Technology.
EXPERIMENTAL STUDY ON PROXIMITY EFFECTS IN HIGH VOLTAGE E-BEAM LITHOGRAPHY
E. Boere, E. vanderDrift, Johannes Romijn, and B. Rousseeuw *In its* Metallic Structures with Reduced Dimensions 1991 p 37-46 Repr. from Proceedings Micro Circuit Engineering Conference 1989, Cambridge, England (Amsterdam, Netherlands, North Holland Publishing), 1990 p 351-354 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

N92-23084# Technische Univ., Delft (Netherlands).
NANOLITHOGRAPHY WITH ELECTRON MICROSCOPES
In its Metallic Structures with Reduced Dimensions 1991 p 47-54 (For primary document see N92-23080 13-26)
Avail: NTIS HC/MF A07

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N92-22252# Lawrence Livermore National Lab., CA.
ON THE ROCKET EFFICIENCY OF RADIATION DRIVEN TARGETS
S. P. Hatchett and M. D. Rosen Sep. 1991 6 p Presented at the Inertial Fusion Lecture Series, Princeton, NJ, Apr. 1991
(Contract W-7405-eng-48)
(DE92-006884; UCRL-JC-108349; CONF-9104331-2) Avail: NTIS HC/MF A02

Hydrodynamic efficiency is a key element in the determination of the overall efficiency with which incident laser energy is converted into the internal energy of DT fuel in its final compressed state. This overall coupling efficiency is determined by many conversion processes, starting with absorption of laser light, and continuing with conversion of that light to thermal x rays, and transport of those x rays to the target. The x rays are then absorbed in the target and ablate away its outer part, imploding the rest of the sphere in a rocket-like reaction. The efficiency of this particular process, the so-called hydrodynamic efficiency is the focus of this report. The further issue of reconversion of the hydrodynamic energy of implosion into internal energy of the compressed DT is beyond the scope of this work. The efficiency with which absorbed laser light is converted into thermal x rays can approach 90 pct. The x rays flow either into the hohlraum walls or into the target ball. We now proceed to calculate the rocket efficiency in the limit of a low-Z ablator whose heated blowoff is optically thin to the free-streaming incoming flux of energy. Radiation is transported to a relatively narrow region where there is a very large temperature gradient such that the temperature changes by a factor of several or more. This is due to absorption of radiation in a single mean-free-path. This region of abrupt temperature increase, a heat front, is effectively the rocket engine; we shall calculate the efficiency of this engine. Under the physical conditions of radiatively driven ablation, we must also consider the efficiency with which radiative energy is transported to the heat front. DOE

N92-22254# Lawrence Livermore National Lab., CA.
DAMAGE TEST CAPABILITIES USING A HIGH REPETITION RATE VISIBLE LASER AT LLNL
C. J. Stolz, J. R. Taylor, and T. G. Sarginson Oct. 1991 9 p Presented at the SPIE International Society for Optical Engineering Meeting, Boulder, CO, 23-25 Oct. 1991
(Contract W-7405-eng-48)
(DE92-006889; UCRL-JC-108070; CONF-911064-3) Avail: NTIS HC/MF A02

A well-controlled damage testing facility is vital for establishing confidence in production coatings for high-power laser operation and for the understanding of damage phenomena. An upgraded damage test facility at LLNL now allows better control in measuring damage thresholds and absorption of thin film coatings as well as examination of sites where damage first occurs. A description of the system configuration using lasers from the Laser Isotope Separation (LIS) at the Laser Demonstration Facility (LDF) as well as the methods used to acquire damage thresholds will be given. DOE

N92-22621# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. Meteorologische Fernerkundung.
CONSTRUCTION AND TESTING OF AN OZONE-DIFFERENTIAL-ABSORPTION LIDAR Thesis - Technische Univ.
Uwe T. Roesler Apr. 1991 89 p In GERMAN; ENGLISH summary Original contains color illustrations
(DLR-FB-91-17; ISSN-0939-2963; ETN-92-90734) Avail: NTIS HC/MF A05; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 37.50 DM

The Differential Absorption Lidar (DIAL) technique is used to measure the horizontal distribution of ozone in an atmospheric layer near the surface. The laser system, which is designed as a laboratory experiment, provides spatially resolved measurements of the ozone concentration. The quality of measurements is demonstrated, as compared with simulataneous measurements carried out in situ and using the DIAL technique. Daily changes of ozone concentration were measured and discussed. ESA

N92-23110# Allied-Signal Aerospace Co., Kansas City, MO.
DEVELOPMENT OF A LENGTH SCALE CALIBRATION SYSTEM USING LASER EDGE SENSING
R. N. Burton Feb. 1992 62 p
(Contract DE-AC04-76DP-00613)
(DE92-006618; KCP-613-4630) Avail: NTIS HC/MF A04

A measuring system for the calibration of length scales was developed. The system includes a laser-based edge detector, a laser interferometer measurement system, a coordinate measuring machine, and a computer system. The measuring system allows length scales to be calibrated approximately three times faster than was previously possible and with an accuracy of (+/-) 20 microinches. DOE

N92-22478*# Naval Surface Warfare Center, Silver Spring, MD.
LASER DISCRIMINATION BY STIMULATED EMISSION OF A PHOSPHOR
V. K. Mathur and K. Chakrabarti (Advanced Technology and Research, Inc., Laurel, MD.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 476-484 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20E

N92-22479*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
Q-SWITCHED LASER PRELASE DETECTION CIRCUIT
George E. Lockard *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 485-493 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20E

N92-22823# Atmospheric Sciences Lab., White Sands Missile Range, NM.
ANALYSIS ALGORITHMS FOR PROCESSING ULTRAVIOLET FLUORESCENCE DATA
J. B. Gillespie, D. L. Rosen, Y. P. Yee, and R. Gonzales *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)
Copyright Avail: NTIS HC/MF A15; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-22938# Quebec Univ., Varennes.
PLASMA PARAMETERS AND CONVERSION RATES IN LASER-SOLID INTERACTIONS AT 0.26 MICROMETERS: APPLICATION TO THE CALCULATION OF RADIATIVE LOSSES IN HYDRODYNAMIC SIMULATIONS [PARAMETRES DE PLASMA ET RENDEMENT DE CONVERSION DANS L'INTERACTION LASER-SOLIDE A 0.26 MICROMETRES: APPLICATION AU CALCUL DES PERTES RADIATIVES DANS LES SIMULATIONS HYDRODYNAMIQUES]
S. Boily (Ecole Polytechnique, Palaiseau, France) and Jean-Claude Gauthier *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 105-109 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22939# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
COHERENCE TRANSITION IN AN X LASER. NUMERIC CODE FOR THE BLOCH-MAXWELL EQUATIONS [TRANSITION VERS LA COHERENCE DANS UN LASER X: CODE NUMERIQUE POUR LES EQUATIONS DE BLOCH-MAXWELL]
Patrick Lautard, Alain Sureau, and Pierre Jaegle *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 111-118 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22943# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
ATOMIC DATA FOR A RECOMBINATION X LASER SCHEME [DONNEES ATOMIQUES POUR UN SCHEMA DE LASER X PAR RECOMBINAISON]
Helene Guennou, Annie Klisnick, Claire Moeller, and Alain Sureau *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 134-139 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22944# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
AMPLIFICATION AT 65 A OF LITHIUM-LIKE SULFUR [AMPLIFICATION A 65 A DANS LE SOUFRE LITHUMOIDE]
Jean-Pierre Raucourt, Antoine Carillon, Bernard Gauthe, Pierre Jaegle, Gerard Jamelot, and Annie Klisnick *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 140-143 In FRENCH (For primary document see N92-22918 13-75)
(Contract DRET-88-236)
Avail: NTIS HC/MF A12

N92-22952# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
LASER DIAGNOSTICS IN IMPLOSION EXPERIMENTS [DIAGNOSTICS LASER DANS LES EXPERIENCES D'IMPLOSION]
Michel Koenig, Victor Malka, Edouard Fabre, Dimitri Batani, Anne-Marie Tournade, Alain Michard, and Jean-Michel Boudenne *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 193-198 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22953# Ecole Polytechnique, Palaiseau (France). Lab. de Physiques des Milieux Ionises.
STUDY OF FOCAL PATCHES AND ABLATION OF TIN AND SAMARIUM LAYERS WITH A RANDOM PHASE PLATE AT WAVELENGTHS OF 0.53 MICROMETERS [ETUDE DES TACHES FOCALES ET DE L'ABLATION DE COUCHES D'ETAIN ET SAMARIUM AVEC UNE LAME DE PHASE ALEATOIRE A LA LONGUEUR D'ONDE 0.53 MICROMETRES]
Claude Chenais-Popovics, Patrick Renaudin, Christina A. Back, Patrick Audebert, Jean-Paul Geindre, and Jean-Claude Gauthier *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 199-204 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

N92-22959# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
ACTIVITIES OF THE LASER GROUP [ACTIVITE DE GROUPE LASER]
Ji-Ping Zou, Anne-Marie Tournade, and Sylvain Savalle *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 228-231 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-22132 State Univ. of New York, Stony Brook.
PRINCIPLES AND COMPUTER SIMULATIONS OF INTERCOOLED-TURBOCHARGED GAS GENERATOR/EXPANDER ENGINE Ph.D. Thesis
Yuan-Liang Jeng 1991 183 p
Avail: Univ. Microfilms Order No. DA9205246

An internal combustion engine is proposed that is based on a patent of Dr. L. S. Wang. This engine utilizes a two-stage adiabatic

compression with intercooling to reduce exhaust energy loss, and a reciprocating piston-gasifier to raise the cycle peak temperature. Combustion occurs within piston-gasifier to generate high temperature and pressure gases with no brake net work output. The discharge gas expands in turbocharging turbine to drive the two compressors. Further expansion is performed in the power turbine to produce the engine power output. To study the feasibility of the proposed engine, piston-gasifier is designed and computer code was developed to simulate the engine operations. Processes in various system components are described by several submodels which are integrated in the computer code to predict the engine performance. The piston-gasifier model treats manifolds and cylinders as open systems and combustion is described as a one-zone heat release process. Processes including heat transfer and friction are described in sufficient detail to determine the mass and energy transfers in each manifold and master cylinder. The power turbine is described by the modified Stodola Ellipse while other machineries are described by scaled performance maps. Intercoolers are modeled by a combination of analytical solutions and empirical correlations. The predicted quasi-steady performance characteristics of piston-gasifier are studied. And a reference operating point is chosen to select turbomachineries and to design intercoolers. The system performance is obtained by matching the operations of all components. Covering a wide range of operations, the results of engine simulations show that excellent part load performance is obtained by the reduction of exhaust energy loss. Still liable to refinements, discussions are made, pointing out future directions of further improvement.

Dissert. Abstr.

N92-22198 Minnesota Univ., Minneapolis.
A DESIGN FRAMEWORK FOR TELEROBOTIC CONTROL Ph.D. Thesis
Tsing-luan Tsay 1991 127 p
Avail: Univ. Microfilms Order No. DA9202850

A telerobotic system is composed of a pair of robots electronically connected to provide a longer reach for a human operator. It allows a human operator to hold one of the robots (the master robot) to control the other robot (the slave robot) to manipulate an environment from a remote and safe location. The key concept of this thesis is 'telefunctioning'. It is defined as a robotic manipulation in which the dynamic behaviors of the slave robot and master robot are functions of each other. These functions are the designer's choice and depend on the application. In order to achieve telefunctioning, a new control system is proposed in which two force feedbacks from both robots are used. The goal of this thesis is to develop a design framework for obtaining a bilateral force reflecting controller for a telerobotic system to achieve telefunctioning. The theoretical results are experimentally verified on a two degree of freedom telerobotic system. Specific experimental demonstrations include unconstrained and constrained telemanipulators. Author

N92-22199 Florida Univ., Gainesville.
INTERFERENCE AVOIDANCE OF ROBOT MANIPULATORS USING ARTICULATION AND TIME SCHEDULING Ph.D. Thesis
Ming-Jer Lin 1991 181 p
Avail: Univ. Microfilms Order No. DA9202027

The kinematic and geometric questions associated with a robot manipulator moving in an environment having obstacles or adjacent manipulators are discussed. The kinematic and geometric properties of a robot manipulator are analyzed in terms of its articulation, which is used to describe the capacity of the robot manipulator to continuously change its configuration while its end effector follows a prescribed path with free orientation. The articulation of spatial robots with special geometries such as PUMA and TRS robots is analyzed by determining the permissible, allowable and favorable orientations of robot links, which are used to describe motion capability of the robot links. This analysis gives a range of favorable orientations which can be used to plan an interference-free motion of a robot manipulator to avoid spherical and polyhedral obstacles or an adjacent manipulator. A time scheduling scheme of two robot manipulators moving in a coordinated manner is also presented. A potential collision region is obtained by detecting collisions along rectilinear trajectories of the manipulators using a sphere model for the end effector.

Author

N92-22207*# North Carolina State Univ., Raleigh. Mars Mission Research Center.
DISTRIBUTED DIGITAL SIGNAL PROCESSORS FOR MULTI-BODY FLEXIBLE STRUCTURES Final Report
Gordon K. F. Lee 6 Apr. 1992 76 p
(Contract NCC1-1136)
(NASA-CR-190183; NAS 1.26:190183) Avail: NTIS HC/MF A05 CSCL 13I

Multi-body flexible structures, such as those currently under investigation in spacecraft design, are large scale (high-order) dimensional systems. Controlling and filtering such structures is a computationally complex problem. This is particularly important when many sensors and actuators are located along the structure and need to be processed in real time. This report summarizes research activity focused on solving the signal processing (that is, information processing) issues of multi-body structures. A distributed architecture is developed in which single loop processors are employed for local filtering and control. By implementing such a philosophy with an embedded controller configuration, a supervising controller may be used to process global data and make global decisions as the local devices are processing local information. A hardware testbed, a position controller system for a servo motor, is employed to illustrate the capabilities of the embedded controller structure. Several filtering and control structures which can be modeled as rational functions can be implemented on the system developed in this research effort. Thus the results of the study provide a support tool for many Control/Structure Interaction (CSI) NASA testbeds such as the Evolutionary model and the nine-bay truss structure. Author

N92-22265 Carnegie-Mellon Univ., Pittsburgh, PA.
CONFIGURATION OF AUTONOMOUS WALKERS FOR EXTREME TERRAIN Ph.D. Thesis
John Evan Bares 1991 168 p
Avail: Univ. Microfilms Order No. DA9126933

Advantageous candidate walker configurations are synthesized and analyzed, a walker of novel capability and design is implemented and tested, and insights are developed regarding walker configuration and the class of orthogonal-legged walking robots. An orthogonal-legged, level body walker is suited to the mobility, efficiency, accuracy, and autonomous control requirements of extreme terrain exploration. Its legs do not rock during body motion, enabling foot placement in holes, between boulders, and near escarpments. The Ambler is a fully operable, six legged, circulating gait, autonomous walking robot that can traverse extreme terrain. The robot is a novel integration of mechanism, motion control, perception, and planning elements into a wholly autonomous extreme terrain walker. The Ambler has accurately and efficiently traversed terrain of difficulty unattained by any other autonomous legged, wheeled, or tracked vehicle. In doing so, the Ambler verifies that the orthogonal leg and circulating gait configuration are viable for extreme terrain. The Ambler is the first benchmark for autonomous walker mobility, efficiency, and accuracy in extreme terrain. Dissert. Abstr.

N92-22314 Harvard Univ., Cambridge, MA.
TACTILE SENSING WITH COMPLIANT MANIPULATORS Ph.D. Thesis
William Charles Nowlin 1991 143 p
Avail: Univ. Microfilms Order No. DA9132012

We develop techniques and strategies for tactile sensing with compliance using a fluid supported membrane fingertip. Much of this work concerns a method of sensing with compliance based on magnetics, though other forms are discussed. In particular, analysis is carried out to predict the change in measurements due to changes in the shape of the fingertip membrane, and to invert this map. Experiments conducted on a prototype compliant fingertip membrane show that the least squares solution to the

problem of determining the membrane shape behaves poorly in the presence of noise. We present a solution based on Bayesian methods to compute a maximum a posteriori estimate which is stable in the presence of noise in the data. A general test is presented which states a sufficient condition for a product of positive functions to be unimodal. This condition, strict monotonicity of the logarithmic derivatives, applies to a wide variety of density functions. This is applied to a particular problem, that of tactile sensing. Finally, numerical experiments are described which demonstrate the success of the inversion schemes, and the construction of two different prototype fingertips based on magnetics is detailed. Experimental results are presented which demonstrate the ability of each of these prototypes to successfully deconvolve magnetic field measurements into tactile images, and various techniques for improving these results are discussed.
Dissert. Abstr.

N92-22315 Wisconsin Univ., Madison.
DYNAMIC SIMULATION OF A SOLID FUELLED GAS TURBINE SYSTEM Ph.D. Thesis
Carl Alexander Palmer 1991 438 p
Avail: Univ. Microfilms Order No. DA9124683

A computer model for a novel directly fired combustor-gas turbine system using woodchips has been developed. In this downdraft combustor, the fuel burning rate is determined by pressure, temperature, air flow, and fuel moisture; not by the fuel feed rate. This thesis integrates the characteristics of compressor, gas producer, and power turbine sections from an actual turbine with the combustor characteristics in order to understand steady state and dynamic system operation, and to develop a control system. The model qualitatively reproduces experimental data. Active control is needed for moving from one steady state point to another. For changing loads, the bypass valve and house air valves should move simultaneously so that the combustion conditions remain fairly constant, which would keep the system from 'drifting'. The house air valve setting controls the combustion conditions. To change load, active control with the vent valve is used for moving the system from one steady state bypass point to another, using carbon dioxide as the controlled variable. The control should take into account the thermal lag by not being too fast, yet must be fast enough to catch drift. An external motor can start the system using a preheated bed. Dissert. Abstr.

N92-22316 Alabama Univ., University.
LIMIT CYCLE VIBRATIONS IN TURBOMACHINERY Ph.D. Thesis
Stephen Gregory Ryan 1991 250 p
Avail: Univ. Microfilms Order No. DA9130260

High performance turbomachinery is susceptible to a wide variety of vibration problems. Some of these problems are rotor unbalance vibration, dynamic instability, and subharmonic response to unbalance excitation. Understanding these problems is complicated when nonlinearities are present, as they almost always are in hardware. For example, dynamic instabilities may manifest themselves as limit cycle vibrations. In some cases the vibration levels are so high that the distinction between a divergent instability and a limit cycle are meaningless. This is because the machinery would be destroyed in either case. In other cases the limit cycle may appear at relatively small levels. These cases may appear to be benign, however, the presence of the limit cycle may be an indication of an impending divergent instability. This matter is complicated by the fact that the limit cycle instability is frequently near one-half of the unbalance excitation synchronous frequency. This makes it difficult to distinguish between the limit cycle and a subharmonic response. The focus of this work is an examination of rotordynamic systems which are simultaneously susceptible to limit cycle instability and subharmonic response. Characteristics of each phenomenon are determined as well as their interrelationship. A normalized, single mass rotor model is examined as well as a complex model of the High Pressure Fuel Turbopump (HPFTP) of the Space Shuttle Main Engine (SSME). Entrainment of limit cycle instability by subharmonic response is demonstrated for both models. The non-uniqueness of the solution is also demonstrated.
Dissert. Abstr.

N92-23092*# Catholic Univ. of America, Washington, DC. Dept. of Electrical Engineering.
TESTING OF FTS FINGERS AND INTERFACE USING A PASSIVE COMPLIANT ROBOT MANIPULATOR Semiannual Technical Report, 1 Sep. 1991 - 29 Feb. 1992
Charles C. Nguyen and Sami S. Antrazi Apr. 1992 21 p
(Grant NAG5-1415)
(NASA-CR-190241; NAS 1.26:190241) Avail: NTIS HC/MF A03 CSCL 13I

This report deals with testing of a pair of robot fingers designed for the Flight Telerobotic Servicer (FTS) to grasp a cylinder type of Orbital Replaceable Unit (ORU) interface. The report first describes the objectives of the study and then the testbed consisting of a Stewart Platform-based manipulator equipped with a passive compliant platform which also serves as a force/torque sensor. Kinematic analysis is then performed to provide a closed-form solution for the force inverse kinematics and iterative solution for the force forward kinematics using the Newton's Raphson Method. Mathematical expressions are then derived to compute force/torques applied to the FTS fingers during the mating/demating with the interface. The report then presents the three parts of the experimental study on the feasibility and characteristics of the fingers. The first part obtains data of forces applied by the fingers to the interface under various misalignments, the second part determines the maximum allowable capture angles for mating, and the third part processes and interprets the obtained force/torque data. H.A.

N92-23111# Oxford Univ. (England). Dept. of Engineering Science.
TIME-FREQUENCY DOMAIN ANALYSIS OF VIBRATION SIGNALS FOR MACHINERY DIAGNOSTICS. 2: THE WEIGHTED WIGNER-VILLE DISTRIBUTION
P. D. McFadden and W. J. Wang 1991 46 p Sponsored by Science Research Council
(OUEL-1891/91; ETN-92-91087) Avail: NTIS HC/MF A03

The application of sliding weighting functions to the Wigner-Ville distribution is examined. The effect of the weighting function on the time frequency distribution is discussed and it is shown that the level of the interference terms, the production of aliasing errors, and the repetition terms in the weighted Wigner-Ville distribution are significantly reduced. It is suggested that the Gaussian function provides a suitable form of weighting function. A digital computer program implementing the discrete weighted Wigner-Ville distribution is described and its performance is demonstrated by the analysis in the time frequency domain of a series of numerically generated test signals. It was shown previously that the Wigner-Ville distribution may be applied to the analysis of the time frequency domain of experimentally measured time domain averages of the vibration of gears in industrial and helicopter gearboxes, in order to detect early signs of impending mechanical failure. It is shown that the damage to the gears can be detected by visual inspection of the changes which occur on the pattern of the weighted Wigner-Ville distribution more easily than they could with the original unweighted Wigner-Ville distribution. ESA

N92-22329*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVALUATION OF FORCE-TORQUE DISPLAYS FOR USE WITH SPACE STATION TELEROBOTIC ACTIVITIES
Robert C. Hendrich, John M. Bierschwale, Meera K. Manahan, Mark A. Stuart (Lockheed Engineering and Sciences Co., Houston, TX.), and A. Jay Legendre *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 454-459 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 13I

N92-22426*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
WELDING TECHNOLOGY TRANSFER TASK/LASER BASED WELD JOINT TRACKING SYSTEM FOR COMPRESSOR GIRTH WELDS
Alan Looney *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 24-31 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 13H

N92-22427*# EG and G Rocky Flats, Inc., Golden, CO.
PRECISION JOINING CENTER
John W. Powell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 32-35 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 13H

N92-22681*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE CLIMBING CRAWLING ROBOT (A UNIQUE CABLE ROBOT FOR SPACE AND EARTH)
James J. Kerley, Edward May, and Wayne Eklund *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 43-50 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13I

N92-22682*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A LIGHTWEIGHT, HIGH STRENGTH DEXTEROUS MANIPULATOR FOR COMMERCIAL APPLICATIONS
Neville I. Marzwell, Bruce M. Schena, and Steve M. Cohan (Odetics, Inc., Anaheim, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 51-59 (For primary document see N92-22676 13-99)
(Contract NAS7-1062)
Avail: NTIS HC/MF A22 CSCL 13I

N92-22683*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REAL-TIME, INTERACTIVE, VISUALLY UPDATED SIMULATOR SYSTEM FOR TELEPRESENCE
Frederick S. Schebor, Jerry L. Turney (KMS Industries, Ann Arbor, MI.), and Neville I. Marzwell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 60-70 (For primary document see N92-22676 13-99)
(Contract NAS7-1074)
Avail: NTIS HC/MF A22 CSCL 13I

N92-22684*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A HAZARD CONTROL SYSTEM FOR ROBOT MANIPULATORS
Ruth Chiang Carter and Adrian Rad (Hernandez Engineering, Inc., Greenbelt, MD.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 71-80 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13I

N92-22689*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF A ROTARY JOINT FLUID COUPLING FOR SPACE STATION FREEDOM
John A. Costulis *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 119-128 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

N92-22690*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPLINE-LOCKING SCREW FASTENING STRATEGY (SLSFS)
John M. Vranish *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 129-135 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

N92-22691*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
QUICK APPLICATION/RELEASE NUT WITH ENGAGEMENT INDICATOR (COMMERCIAL APPLICATION OF AN INNOVATIVE NUT DESIGN)
Jay M. Wright *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 136-139 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

N92-22692*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INFLATABLE TRAVERSING PROBE SEAL
Paul A. Trimarchi *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 140-145 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

N92-22712*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A COST-EFFECTIVE INTELLIGENT ROBOTIC SYSTEM WITH DUAL-ARM DEXTEROUS COORDINATION AND REAL-TIME VISION
Neville I. Marzwell and Alexander Y. K. Chen (Scientific Research Associates, Inc., Glastonbury, CT.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 311-324 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-22686*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ADVANCED COMPUTED TOMOGRAPHY INSPECTION SYSTEM (ACTIS): AN OVERVIEW OF THE TECHNOLOGY AND ITS APPLICATION
Lisa H. Hediger *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 93-100 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14D

N92-22687*# Information Research Lab., Inc., Dartmouth, MA.
HIGH RESOLUTION ULTRASONIC SPECTROSCOPY SYSTEM FOR NONDESTRUCTIVE EVALUATION
C. H. Chen *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 101-104 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14D

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N92-22133 Air Force Inst. of Tech., Wright-Patterson AFB, OH.
HIGHER-ORDER THICKNESS EXPANSIONS FOR CYLINDRICAL SHELLS Ph.D. Thesis
Randy A. Smith 1991 259 p
Avail: Univ. Microfilms Order No. DA9201804

Eight variations of higher order transverse shear deformation (HTSD) theory were developed for composite shells. Three attributes were varied to produce the eight variations. These attributes included the order of the thickness expansions used to approximate the shell shape factors and the assumed linear displacement field and the nonlinearity of the transverse shear strain. Several cylindrical shell problems were investigated using SHELL, a finite element code with a 36 degree of freedom cylindrical shell element. MACSYMA, a symbolic manipulation code, was used to formulate the element independent stiffness arrays for each variation of the theory. When all nonlinear strain displacement terms for transverse shear were included for thin shallow isotropic cylindrical shells, the theory predicted a more flexible response during collapse. Author

N92-22201 Cornell Univ., Ithaca, NY.
FRACTURE MECHANISMS IN ZINC SULFIDE CERAMIC TOUGHENED WITH DIAMOND PARTICLES Ph.D. Thesis
Donald S. Farquhar 1991 212 p
Avail: Univ. Microfilms Order No. DA9203945

The room temperature mechanical properties of zinc sulfide ceramic composites reinforced with diamond particles were measured experimentally. Procedures were developed to determine the elastic moduli, the flexural strength, the yield strength, and the fracture toughness of the composites. A special feature of the measurement techniques is their suitability for use with very small specimens (approx. 1 gm). A new experimental technique for making high resolution crack opening displacement measurements was developed to investigate the influence of the microstructure on toughening. The fracture toughness of each material was calculated from the displacements in the K-dominant region, and the extent of the crack tip process zone was determined. All of the composites had similar near crack tip displacements which suggested that the fracture toughness of the matrix is the local criteria for crack growth. An elastic model was developed to describe the role of particle size and volume fraction on toughening. Well bonded elastic particles in a brittle elastic matrix were assumed. The model agrees with the experimental results for the 0 to 1 micron particle size composites, and predicts a strong dependence of toughness on diamond particle volume fraction for this mechanism. The results demonstrated that high resolution measurement of crack opening displacement is an effective experimental technique for determining the fracture mechanisms in ceramic particulate composites. The experimental technique was difficult to apply, but straightforward to model, in contrast to the widely used Vickers indentation test.
Dissert. Abstr.

N92-22227*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPROVED ACCURACY FOR FINITE ELEMENT STRUCTURAL ANALYSIS VIA A NEW INTEGRATED FORCE METHOD
Surya N. Patnaik (Ohio Aerospace Inst., Brook Park.), Dale A. Hopkins, Robert A. Aiello, and Laszlo Berke Apr. 1992 28 p
(NASA-TP-3204; E-5638; NAS 1.60:3204) Avail: NTIS HC/MF A03 CSCL 20K

A comparative study was carried out to determine the accuracy of finite element analyses based on the stiffness method, a mixed method, and the new integrated force and dual integrated force methods. The numerical results were obtained with the following software: MSC/NASTRAN and ASKA for the stiffness method; an MHOST implementation method for the mixed method; and GIFT for the integrated force methods. The results indicate that on an overall basis, the stiffness and mixed methods present some limitations. The stiffness method generally requires a large number of elements in the model to achieve acceptable accuracy. The MHOST method tends to achieve a higher degree of accuracy for course models than does the stiffness method implemented by MSC/NASTRAN and ASKA. The two integrated force methods, which bestow simultaneous emphasis on stress equilibrium and strain compatibility, yield accurate solutions with fewer elements in a model. The full potential of these new integrated force methods remains largely unexploited, and they hold the promise of spawning new finite element structural analysis tools. Author

N92-22242 National Physical Lab., Teddington (England). Div. of Materials Metrology.
ANALYSIS OF TRANSVERSE VARIATION OF YOUNG'S MODULUS WITHIN A NARROW BEAM
D. H. Ferris Sep. 1991 14 p
(NPL-DMM(A)-34; ISSN-0959-2423; ETN-92-91198) Copyright
Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

It is shown how simple beam theory can be modified to allow for a transverse variation of Young's Modulus. This theory is used as a basis for determining variations in modulus by removing successive longitudinal layers from the beam and subsequent experimental determination of the corresponding flexural rigidities. Some typical experimental beam response results are analyzed to indicate variation of Young's Modulus in the through thickness direction. ESA

N92-22248# Naval Postgraduate School, Monterey, CA.
RESONANT ACOUSTIC DETERMINATION OF COMPLEX ELASTIC MODULI M.S. Thesis
Beng H. Tan Mar. 1991 136 p
(AD-A245058) Avail: NTIS HC/MF A07 CSCL 20/11

An acoustic resonance based technique using a free-free bar has been extended to investigate the complex (storage and loss) moduli of nonmagnetic materials having circular cross section. Using this technique, the bar can be selectively excited in three independent vibrational modes, i.e., torsional, flexural, and longitudinal modes. The torsional mode yields the shear modulus. Either the flexural or longitudinal modes can be used to obtain Young's modulus. These resonant modes can be tracked continuously by means of a phase locked loop (PLL) as the temperature (and resonant frequency) of the rod is changed. The in-phase amplitude of the receiver output of the electrodynamic transducer is proportional to the quality factor, Q, of the material. It can be used to continuously track the loss tangent (=1/Q) of the material as a function of temperature and frequency. Results for complex shear modulus and Young's modulus were obtained for a castable epoxy type PR1592 and complex shear modulus for polymethyl methacrylate (PMMA) and Uralite 3130. Over the temperature and frequency range that was accessible, a clear viscoelastic transition was observed in both the storage modulus and loss tangent curves of PR1592. GRA

N92-22250*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Composite Materials and Structures.
POSTBUCKLING FAILURE OF COMPOSITE PLATES WITH CENTRAL HOLES Interim Report, Feb. 1990 - Dec. 1991 Ph.D. Thesis
H. H. Lee and M. W. Hyer Feb. 1992 331 p
(Grant NAG1-901)
(NASA-CR-190210; NAS 1.26:190210; VPI-E-92-07; CCMS-92-07)
Avail: NTIS HC/MF A15 CSCL 20K

The postbuckling failure of square composite plates with central holes is analyzed numerically and experimentally. The particular plates studies have stacking sequences of: (+ and - 45/0/90)(sub 2S); (+ and - 45/0(sub 2))(sub 2S); (+ and - 45/0(sub 6))(sub S); and (+ and - 45)(sub 4S). A simple plate geometry, one with a hole diameter to plate width ratio of 0.3 is compared. Failure load, failure mode, and failure location are predicted numerically

by using the finite element method. Predictions are compared with experimental results. In numerical failure analysis the interlaminar shear stresses, as well as the inplane stresses are taken into account. An issue addressed in this study is the possible mode shape change of the plate during loading. It is predicted that the first three laminates fail due to excessive stresses in the fiber direction, and more importantly, that the load level is independent of whether the laminate is deformed in a one-half or two-half wave configuration. It is predicted that the fourth laminate fails due to excessive inplane shear stress. Interlaminar shear failure is not predicted for any laminates. For the first two laminates the experimental observations correlated well with the predictions. Experimentally, the third laminate failed along the side support due to interlaminar shear strength S(sub 23). The fourth experimental laminate failed due to inplane shear in the location predicted, however material softening resulted in a different failure load from predictions. Author

N92-22264 Cranfield Inst. of Tech., Bedford (England).
EFFICIENT FRACTURE MECHANICS PROGRAMMING SYSTEM FOR LINEAR AND NONLINEAR PROBLEMS USING FINITE ELEMENT AND BOUNDARY ELEMENT METHODS Ph.D. Thesis
Ameen Ahmed Nassar Al-Edani 1990 483 p
Avail: Univ. Microfilms Order No. BRDX92920

An attempt was made to design an efficient, linear elastic and elastoplastic, fracture mechanics package based upon finite and boundary element methods. The package contains many useful facilities such as pre- and post-processors, different types of loading including inertial and thermal loading, and different types of finite and boundary elements. New crack tip elements, and efficient algorithms for the analysis of J-integrals, were derived. Elasto-plastic boundary element programs with different types of loading, and using a new subregion facility, were also developed. The package was used for fracture mechanics analysis of some case studies with elastic, thermo-elastic, and elasto-plastic conditions, and with one and two modes of fracture. The results proved that the package is very reliable and controllable, and new facilities and techniques developed can provide useful tools for fracture mechanics analysis. Dissert. Abstr.

N92-22267*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROBABILISTIC STRUCTURAL ANALYSIS OF ADAPTIVE/SMART/INTELLIGENT SPACE STRUCTURES
Shantaram S. Pai and Christos C. Chamis 1991 20 p
(NASA-TM-105408; E-6637; NAS 1.15:105408) Avail: NTIS HC/MF A03 CSCL 20K

A three-bay, space, cantilever truss is probabilistically evaluated for adaptive/smart/intelligent behavior. For each behavior, the scatter (ranges) in buckling loads, vibration frequencies, and member axial forces are probabilistically determined. Sensitivities associated with uncertainties in the structure, material and load variables that describe the truss are determined for different probabilities. The relative magnitude for these sensitivities are used to identify significant truss variables that control/classify its behavior to respond as an adaptive/smart/intelligent structure. Results show that the probabilistic buckling loads and vibration frequencies increase for each truss classification, with a substantial increase for intelligent trusses. Similarly, the probabilistic member axial forces reduce for adaptive and intelligent trusses and increase for smart trusses. Author

N92-22279*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF TEST-ANALYSIS MODELS (TAM) FOR CORRELATION OF DYNAMIC TEST AND ANALYSIS RESULTS
Filippo Angelucci, Mehzad Javeed (Lockheed Engineering and Sciences Co., Hampton, VA.), and Paul McGowan Feb. 1992 112 p
(NASA-TM-104228; NAS 1.15:104228) Avail: NTIS HC/MF A06 CSCL 20K

The primary objective of structural analysis of aerospace applications is to obtain a verified finite element model (FEM). The verified FEM can be used for loads analysis, evaluate structural modifications, or design control systems. Verification of the FEM is generally obtained as the result of correlating test and FEM models. A test analysis model (TAM) is very useful in the correlation process. A TAM is essentially a FEM reduced to the size of the test model, which attempts to preserve the dynamic characteristics of the original FEM in the analysis range of interest. Numerous methods for generating TAMs have been developed in the literature. The major emphasis of this paper is a description of the procedures necessary for creation of the TAM and the correlation of the reduced models with the FEM or the test results. Herein, three methods are discussed, namely Guyan, Improved Reduced System (IRS), and Hybrid. Also included are the procedures for performing these analyses using MSC/NASTRAN. Finally, application of the TAM process is demonstrated with an experimental test configuration of a ten bay cantilevered truss structure. Author

N92-22281*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CLOSED-FORM ANALYSIS OF FIBER-MATRIX INTERFACE STRESSES UNDER THERMO-MECHANICAL LOADINGS
Rajiv A. Naik (Analytical Services and Materials, Inc., Hampton, VA.) and John H. Crews, Jr. Mar. 1992 33 p Presented at the 11th ASTM Symposium on Composite Materials: Testing and Design, Pittsburgh, PA, 4-5 May 1992
(NASA-TM-107575; NAS 1.15:107575) Avail: NTIS HC/MF A03 CSCL 20K

Closed form techniques for calculating fiber matrix (FM) interface stresses, using repeating square and diamond regular arrays, were presented for a unidirectional composite under thermo-mechanical loadings. An Airy's stress function micromechanics approach from the literature, developed for calculating overall composite moduli, was extended in the present study to compute FM interface stresses for a unidirectional graphite/epoxy (AS4/3501-6) composite under thermal, longitudinal, transverse, transverse shear, and longitudinal shear loadings. Comparison with finite element results indicate excellent agreement of the FM interface stresses for the square array. Under thermal and longitudinal loading, the square array has the same FM peak stresses as the diamond array. The square array predicted higher stress concentrations under transverse normal and longitudinal shear loadings than the diamond array. Under transverse shear loading, the square array had a higher stress concentration while the diamond array had a higher radial stress concentration. Stress concentration factors under transverse shear and longitudinal shear loadings were very sensitive to fiber volume fraction. The present analysis provides a simple way to calculate accurate FM interface stresses for both the square and diamond array configurations. Author

N92-22388*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FINITE-ELEMENT-ANALYSIS MODEL AND PRELIMINARY GROUND TESTING OF CONTROLS-STRUCTURES INTERACTION EVOLUTIONARY MODEL REFLECTOR
Mercedes C. Reaves, W. Keith Belvin, and James P. Bailey (Lockheed Engineering and Sciences Co., Hampton, VA.) May 1992 51 p
(NASA-TM-4293; L-17009; NAS 1.15:4293) Avail: NTIS HC/MF A04 CSCL 20K

Results of two different nonlinear finite element analyses and preliminary test results for the final design of the Controls-Structures Interaction Evolutionary Model are presented. Load-deflection data bases are generalized from analysis and testing of the 16-foot diameter, dish shaped reflector. Natural frequencies and mode shapes are obtained from vibrational analysis. Experimental and analytical results show similar trends; however, future test hardware modifications and finite element model refinement would be necessary to obtain better correlation. The two nonlinear analysis procedures are both adequate techniques for the analysis of prestressed structures with complex geometries. Author

N92-22421 Politecnico di Milano (Italy). Centro Teoria dei Sistemi.

REJECTION OF CONSTANT AND PERIODIC DISTURBANCES BY MEANS OF OBSERVER DESIGN

G. DeNicolao, F. Lorito, and S. Strada 1991 9 p Sponsored by Ministero Ricerca Scientifica e Tecnologica

(Rept-91-046; ETN-92-91181) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Rejection of periodic disturbances, an important goal in several control problems, especially in the area of active control of vibration and noise, is considered. Standard design techniques for the control of time invariant systems, such as LQ regulation and pole placement, may lead to a damping of periodic disturbances but, in general, do not guarantee their complete rejection. A method for complete rejection of periodic and constant disturbances is developed. The basic idea is to perform an estimate of the disturbance by a suitable observer, and then design the control action so as to cancel out the estimated disturbance. An important feature of the approach is that the design of rejection control action can be performed independently of the adopted stabilization technique. For the sake of conciseness, linear time invariant systems with complete measurements (the state of the system accessible) are considered. ESA

N92-22509# Technion - Israel Inst. of Tech., Haifa. Faculty of Aerospace Engineering.

A CURVED AXISYMMETRIC SHELL ELEMENT FOR NONLINEAR DYNAMIC ELASTOPLASTIC PROBLEMS. PART 1: FORMULATION

R. Ben-Zvi, A. Libai, and M. Perl May 1989 34 p Sponsored by Louis Rogov Research Fund

(TAE-639-Pt-1) Avail: NTIS HC/MF A03

A numerical procedure based on a curved C(sup 1) shell element is developed for the solution of nonlinear dynamic problems of elastoplastic axisymmetric shells of revolution and plane bending of cylindrical shells or beams. The element development is based on approximations to the strain rate and angular velocity distributions in the element. Some additional features of the procedure include: time dependent thickness changes, linearly varying normal stress distribution in the thickness direction, inclusion of transverse shear and normal stresses in the yield envelope, and the adaptation of the radial return method of Krieg to the resulting mixed constitutive equations. The procedure is useful especially for solving problems associated with short duration large deformation elastic and inelastic responses to intense impulsive loads. In the present paper, the theoretical background, element development and constitutive relations are presented and discussed. Problems associated with implementation, as well as some nontrivial examples are presented in part 2 of this paper. Author

N92-22607 Clemson Univ., SC.

A NEW BIAXIAL STRESS FRACTURE CRITERION Ph.D. Thesis

David Ellis Richardson 1991 146 p

Avail: Univ. Microfilms Order No. DA9203157

The development and experimental verification is presented of a new two parameter fracture criterion which is more accurate than the traditional constant fracture toughness (K sub IC) approach of linear elastic fracture mechanics. Fundamental to the theory is the introduction of the concept of equivalent remote biaxial stresses. These are the stresses which, when applied to an infinite cracked panel, give near crack tip stresses that are equivalent to those in an arbitrary notched coupon. In the theory, both K sub I and T (representing the first two terms in the series expansion of the near crack tip stresses) are used as similitude parameters. Thus, the model allows for a much larger fracture process zone than that permitted in the linear elastic fracture mechanics approach where only K sub I is used as a similitude parameter. The equivalent remote biaxial stresses are shown to be very sensitive to differences in fracture toughness due to coupon geometry. The materials tested were polymethyl methacrylate, and two Al alloys. The results of the testing show that the new theory does indeed predict fracture behavior better than the linear elastic fracture mechanics approach even for brittle polymethyl methacrylate. Dissert. Abstr.

N92-22649*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

A PARALLEL-VECTOR ALGORITHM FOR RAPID STRUCTURAL ANALYSIS ON HIGH-PERFORMANCE COMPUTERS

Olaf O. Storaasli, Duc T. Nguyen, and Tarun K. Agarwal (Old Dominion Univ., Norfolk, VA.) Apr. 1990 20 p Presented at the AIAA/ASME/ASCE/AHS 31st Structures, Structural Dynamics and Materials Conference, Long Beach, CA, 2-4 Apr. 1990 Previously announced in IAA as A90-29293

(Grant NAG1-858)

(NASA-TM-102614; NAS 1.15:102614; AIAA-90-1149) Avail: NTIS HC/MF A03 CSCL 20K

A fast, accurate Choleski method for the solution of symmetric systems of linear equations is presented. This direct method is based on a variable-band storage scheme and takes advantage of column heights to reduce the number of operations in the Choleski factorization. The method employs parallel computation in the outermost DO-loop and vector computation via the loop unrolling technique in the innermost DO-loop. The method avoids computations with zeros outside the column heights, and as an option, zeros inside the band. The close relationship between Choleski and Gauss elimination methods is examined. The minor changes required to convert the Choleski code to a Gauss code to solve non-positive-definite symmetric systems of equations are identified. The results for two large scale structural analyses performed on supercomputers, demonstrate the accuracy and speed of the method. Author

N92-22962# Aerospace Corp., El Segundo, CA. Engineering and Technology Group.

DESIGN PREDICTION FOR LONG-TERM STRESS RUPTURE. SERVICE OF COMPOSITE PRESSURE VESSELS

E. Y. Robinson 1 Dec. 1991 46 p Presented at the 9th DOD/NASA/FAA Conference on Fibrous Composites in Structural Design, Lake Tahoe, NV, 4-7 Nov. 1991 Sponsored in part by Navy

(Contract F04701-88-C-0089)

(ATR-92(2743)-1) Avail: NTIS HC/MF A03

Extensive stress rupture studies on glass composites and Kevlar composites were previously conducted. Some of the data from these studies published over the years were incomplete or were tainted by spurious failures. These data were carefully resurveyed. Updated verified data were defined for both fiberglass and Kevlar composite test strand test specimens. These updated data are analyzed by a convenient form of the bivariate Weibull distribution, to establish a consistent set of design prediction charts that may be used as a conservative basis for predicting the stress rupture life of composite pressure vessels. The updated glass composite data exhibit an invariant Weibull modulus with lifetime. The equations relating service life, homologous load, and probability are given. A similar approach is taken for Kevlar composites, where the updated strand data do show a turndown tendency at long life accompanied by a corresponding change of the Weibull modulus. A modification of the stress rupture equations is presented to incorporate a latent strength drop, and design prediction charts are presented that incorporate such behavior. The methods presented use Cartesian plots of the probability distribution, based on median normalized data that are independent of statistical parameters and are readily defined for any set of test data. Author

N92-23101*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

HIERARCHICAL FLUX-BASED THERMAL-STRUCTURAL FINITE ELEMENT ANALYSIS METHOD

Sandra P. Polesky Apr. 1992 113 p

(NASA-TM-107574; NAS 1.15:107574) Avail: NTIS HC/MF A06 CSCL 20K

A hierarchical flux-based finite element method is developed for both a one and two dimensional thermal structural analyses. Derivation of the finite element equations is presented. The resulting finite element matrices associated with the flux based formulation are evaluated in a closed form. The hierarchical finite elements include additional degrees of freedom in the approximation of the element variable distributions by the use of nodeless variables. The nodeless variables offer increased solution accuracy without the need for defining actual nodes and rediscretizing the finite element model. Thermal and structural responses are obtained from a conventional linear finite element method and exact solutions. Results show that the hierarchical flux-based method can provide improved thermal and structural solution accuracy with fewer elements when compared to results for the conventional linear element method. Author

N92-23109# Sandia National Labs., Albuquerque, NM.
THE APPLICATION OF A MATERIAL-SPATIAL NUMERICAL METHOD TO PENETRATION
D. Sulsky, Zhen Chen, and H. L. Schreyer Jan. 1992 56 p
(Contract DE-AC04-76DP-00789)
(DE92-006616; SAND-91-7095) Avail: NTIS HC/MF A04

Penetration is a problem displaying large deformation, the creation of new free surfaces, and material failure. Conventional numerical procedures exhibit difficulties with large mesh distortion for Lagrangian schemes and application of material constitutive equations for spatial approaches. A new numerical scheme involving the flow of material points through a fixed Eulerian grid is described. Constitutive equations are applied at the material points while gradients are invoked through the use of the fixed grid so mesh distortion is not a factor. The procedure of mapping between the material and spatial points is described within the framework of conventional finite element technology. Numerical solutions to one dimensional model problems of impacting elastic and elastic-plastic bars, and of normal penetration, are given to illustrate the features of the proposed approach. The results are consistent with the conventional finite element method. Based on these preliminary examples, other examples involving suspended solid particles in fluids, and on the theoretical basis developed here and elsewhere, the method holds great promise for circumventing the difficult features present in penetration and other impact problems. DOE

N92-23115*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXPERIMENTAL BEHAVIOR OF GRAPHITE-EPOXY Y-STIFFENED SPECIMENS LOADED IN COMPRESSION
P. Daniel Sydow and Mark J. Shuart May 1992 20 p
(NASA-TP-3171; L-16918; NAS 1.60:3171) Avail: NTIS HC/MF A03 CSCL 20K

An experimental investigation of the behavior of graphite-epoxy Y-stiffened specimens loaded in compression is presented. Experimental results are presented for element specimens with a single stiffener and for panel specimens with three stiffeners. Response and failure characteristics of the specimens are described. Effects of impact damage on structural response for both specimen configurations are also presented. Experimental results indicate that impact location may significantly affect the residual strength of the Y-stiffened specimens. The failure results indicate that the critical failure mode is buckling of the stiffener webs for Y-stiffened element specimens and buckling of the stiffener webs and other stiffener blades for the Y-stiffened panel specimens. Author

N92-22377*# Phillips Lab., Kirkland AFB, NM. Space Kinetic Impact and Debris Branch.
ANALYSIS OF ENERGY DISSIPATION AND DEPOSITION IN ELASTIC BODIES IMPACTING AT HYPERVELOCITIES
David F. Medina and Firooz A. Allahdadi *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 750-755 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20K

N92-22380*# New Mexico Inst. of Mining and Technology, Socorro. Center for Explosives Technology Research.
SIMULATING HYPERVELOCITY IMPACT EFFECTS ON STRUCTURES USING THE SMOOTHED PARTICLE HYDRODYNAMICS CODE MAGI
Larry Libersky, Firooz A. Allahdadi, and Theodore C. Carney (Advanced Sciences, Inc., Albuquerque, NM.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 763-776 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20K

N92-22514*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CREEP AND FATIGUE RESEARCH EFFORTS ON ADVANCED MATERIALS
John Gayda *In its* Aeropropulsion 1987 Feb. 1990 p 55-63 (For primary document see N92-22510 13-07)
Avail: NTIS HC/MF A21 CSCL 20K

N92-22688*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FORCE LIMITED VIBRATION TESTING
Terry D. Scharton *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 105-115 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20K

42 GEOSCIENCES (GENERAL)

N92-22826# European Space Agency, Paris (France).
REPORT OF THE EARTH OBSERVATION USER CONSULTATION MEETING
C. Barron, ed. and B. Battrick, ed. Oct. 1991 288 p Meeting held in Noordwijk, Netherlands, 29-31 May 1991 Original contains color illustrations
(ESA-SP-1143; ISBN-92-9092-148-X; ETN-92-91204) Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

Earth observation is an important component of the Long Term Program being prepared by the European Space Agency for consideration by European Ministers at the meeting of the Agency's council in November 1991. As part of the preparations for this November Council Meeting, a meeting of users decided that the aims were to identify lists of topics that should be addressed by the Agency's Earth Observation programme; list the sets of parameters that need to be measured to attain these objectives; and specify the role of the Space based observations. To facilitate discussion, the various areas of interest were grouped under the four basic thrusts of the Agency's Earth Observation strategy, namely environment, resource management, solid Earth, and meteorology. A fifth division, atmospheric chemistry, was added to facilitate discussion. For individual titles, see N92-22827 through N92-22862.

N92-22827# Meteorological Office, Bracknell (England).
REPORTS OF THE WORKING GROUPS: ENVIRONMENT. WHY OBSERVE THE EARTH'S ENVIRONMENT? **c45**
B. J. Mason *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 9-14 Original contains color illustrations (For primary document see N92-22826 13-42)
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The European Space Agency's strategy concerning the environment is reviewed. The need for an integrated international global climate monitoring and prediction program was emphasized and the main components of this program are tabulated. The necessity of developing a Global Climate Observing System (GFOS), which would detect and monitor climate changes and

hence reduce uncertainties in climate predictions and provide more reliable guidance for policy decisions on remedial action and adaptive strategies aimed at reducing the magnitude and impacts of future climate changes, is stressed. The basic structure of combining space measurements with surface based and airborne direct observations and indirect sounding techniques is underlined. The vital role Europe has to play in the observation and prediction of environmental changes in both global and regional scales and in influencing world opinion on practical and effective remedial action is discussed. In considering what environmental parameters are desirable to measure from space, the generic types of instruments to be used and the degree of accuracy are considered. ESA

N92-22828# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
ATMOSPHERIC CHEMISTRY: INTRODUCTION. BRIEF INTRODUCTION TO ATMOSPHERIC CHEMISTRY **c45**
J. P. Burrows *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 15-23 (For primary document see N92-22826 13-42)
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The European Space Agency's strategy concerning atmospheric chemistry is reviewed. In a brief introduction to atmospheric chemistry, the necessity of obtaining global measurements of ozone and the trace species that determine its concentration is clarified. The effect of atmospheric composition on the climate is considered and how man has adversely affected this composition is expressed. In order to make an accurate assessment of the importance of changes in the chemical composition of the atmosphere, a detailed understanding of the chemical and physical processes that determine the behavior of the atmosphere is needed. The need for models to predict the global consequences of changes in atmospheric composition is expressed. The role of ESA in the remote sensing of atmospheric constituents from space platforms is discussed and the types of instrumentation needed to measure these constituents are presented. ESA

N92-22829# Joint Research Centre of the European Communities, Ispra (Italy). Inst. for Remote Sensing Applications.
RESOURCE MANAGEMENT: INTRODUCTION **c45**
J.-P. Malingreau *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 24-33 (For primary document see N92-22826 13-42)
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The European Space Agency's strategy concerning resource management is reviewed. The need for improved management of Earth resources was stressed. The necessity of monitoring and understanding changes in the Earth's surface characteristics and processes at various scales from local to regional and global, is underlined. The categories of users of space data on the Earth's resources are considered. Their objectives and requirements are reviewed with a view to identifying a number of key recommendations on the types of measurements and instrumentation required to meet the needs of such users, as well as the priorities for Europe in both short and medium terms. Both renewable (agriculture, forestry, etc.) and non renewable sources (geological and mineral resources) were considered. Various levels of recommendations were made: high level recommendations of general nature; instrumentation recommendations; and priorities associated with the development of European instrumentation. ESA

N92-22830# Belgian Royal Observatory, Brussels.
SOLID EARTH: THE PRIORITIES **c46**
P. Paquet *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 34-39 (For primary document see N92-22826 13-42)
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The European Space Agency's strategy concerning the solid Earth program is reviewed. Improvement of current knowledge of the global geopotential fields, both gravity and magnetic, was stressed as the highest priority. It was agreed that the objectives and goals of the planned Aristoteles mission correspond to this priority, and the need to realize this part of the program was stated. The interdisciplinary links of the program were identified, and it was decided that this program could make substantial contributions to research of oceans, climate and global change, atmosphere, ice and land surfaces. ESA

N92-22831# Italian Meteorological Service, Rome.
METEOROLOGY: INTRODUCTION **c47**
B. Bizzarri *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 40-46 (For primary document see N92-22826 13-42)
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The European Space Agency's strategy concerning meteorology is reviewed. It was decided that the focus should be on the observations needed for operational meteorology, defined as nowcasting, including both the qualitative/interactive methods and the supporting mesoscale models, and numerical weather prediction, including the requirements to initialize the models, to validate performance and to study methods of improving the parameterization of physical processes. Despite these limitations, it is evident that once the requirements for operational meteorology are met a substantial basic system for nearly all other climatic environmental applications will automatically be available. The role of satellites and Europe and the requirements for observations from geostationary and polar orbit are presented. The operational conditions for polar meteorological satellites are discussed and the meteorological community's awareness of the ground segment aspects is stressed. ESA

N92-22832# European Space Agency, Paris (France).
BACKGROUND MATERIAL: INTRODUCTION **c43**
P. Goldsmith *In its* Report of the Earth Observation User Consultation Meeting Oct. 1991 p 61-68 Original contains color illustrations (For primary document see N92-22826 13-42)
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Through consulting the wider user/scientific community, progress made in the ESA's Long Term Program for Earth Observation is reviewed and an attempt to ensure that the program meets updated user requirements is made. The progress review covered ERS-1 and ERS-2, the Earth Observation Preparatory Program (EOPP), the Polar Platform Program, Artistoteles, the Solid Earth mission, and Metosat Second Generation. The modularity of the Polar Platform is discussed, and the candidate payload instruments for the first Polar Mission (EPOP-MI) are listed. The need to agree on topics that must be addressed and the role of spaceborne instrumentation within the fields of environment resource management, solid Earth, and meteorology was stressed. ESA

N92-22833# Meteorological Office, Bracknell (England).
ENVIRONMENT: MONITORING AND PREDICTION OF THE GLOBAL ENVIRONMENT **c45**
B. J. Mason *In* ESA, Report of the Earth Observation User Consultation Meeting 71-73 (SEE N92-22826 13-42) Oct. 1991 Original contains color illustrations (For primary document see N92-22826 13-42)
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What the scientific community and end users will require of space technology in order to provide the observations necessary to implement a comprehensive and fully integrated Global Environment Monitoring and Prediction Program over the next decade and beyond is discussed and identified. Some parts of the global observing system are already in place, including the World Climate Research Program (WCRP), and the Tropical Ocean and Global Atmosphere (TOGA). A large component of the total

system, the Global Climate Observing System (GCOS), is considered. Its major components and its relation to the research programs such as WCRP are diagrammatically illustrated. ESA

N92-22834# Meteorological Office, Bracknell (England).
MONITORING CLIMATE AND CLIMATE CHANGE: CLIMATE CHANGE CONCERNS **c45**
J. Houghton *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 74-81 (For primary document see N92-22826 13-42)
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Increasing concern that human activities are inadvertently changing the global climate by the concentration of greenhouse gases and by means of other changes which can upset the complex chemical, dynamic and radiative balance of the atmosphere, ocean and land system resulted in the establishment of an Intergovernmental Panel on Climate Change (IPCC) and the organization of the Second World Climate Conference (SWCC). These resulted in the proposal for a Global Climate Observing System (GCOS) which needs to encompass all components of the climate system: atmosphere, biosphere, ergosphere and oceans. Specific developments required to provide an effective GCOS in the areas of the atmosphere, oceans and land are outlined. The role of space observations in the GCOS is discussed together with data handling, assimilation and interpretation. ESA

N92-22835# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
ATMOSPHERIC CHEMISTRY AND THE BIOSPHERE **c45**
P. Crutzen and G. Megie (Centre National de la Recherche Scientifique, Verrieres-Le Buisson, France) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 82-89 (For primary document see N92-22826 13-42)
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The impact of human activities on the Earth's environment has reached such proportions that effects are clearly observed on a global scale. These effects have led to steady growth in the atmospheric abundance of several radiatively and chemically active trace gases. These emissions influence tropospheric and stratospheric ozone and the Earth's climate, and modify the oxidizing properties and the self-cleaning power of the atmosphere. Scientific details of processes occurring in the stratosphere and troposphere are discussed together with important measurements that must be made to answer certain scientific questions which need to be documented as a prerequisite to a consensus definition of the optimum course of action by the greatest number of nations. A coherent instrument package for atmospheric chemistry is discussed, and ESA's program is reviewed. ESA

N92-22836# Southampton Univ. (England).
PROCESSES AFFECTING THE ENVIRONMENT: OCEAN AND ATMOSPHERIC CIRCULATION **c45**
H. Charnock *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 90-93 Original contains color illustrations (For primary document see N92-22826 13-42)
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Ocean and atmospheric circulation is considered. Programs concerned with the heat transfer within the global climate system and the transfer of fresh water, carbon and other important constituents are also considered. Of particular interest are those concerned with the World Climate Research Program. The basic characteristic of observations for the study of ocean and atmospheric circulation is that they should be global in extent and continuous in time. In many cases they can only be economically provided by satellite. Examples of possible products are given. It is concluded that the basic need is for knowledge of the complicated interactions within the climate system, especially those that affect the ocean. More observation and greater understanding of ocean processes could be stimulated by the development of an operational system for ocean prediction. Continuous global observation is necessary for this, and remote sensing will be the main data source. ESA

N92-22837# Meteorological Office, Bracknell (England).
PRECIPITATION AND THE WATER CYCLE **c47**
K. Browning *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 94-99 (For primary document see N92-22826 13-42)
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Details of the hydrological cycle are considered together with the Global Energy and Water Cycle Experiment (GEWEX) established to observe, understand, model and eventually predict variations of the global hydrological regimes, including changes in regional trends of water resources and their response to change in the environment due to increasing greenhouse gases. The full range of global data needed for GEWEX are given. This includes information on meteorological parameters, irradiation and clouds, ocean surface parameters, and land surface data. Three of the highest priorities for improving global observations for GEWEX are temperature and humidity profiles with high vertical resolution, upper air wind profiles, and precipitation profiles. A table of space-based measurements and instruments especially important to climate related studies of precipitation and the water cycle is presented. ESA

N92-22838# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Lab. de Meteorologie Dynamique.
RADIATION AND THE ENERGY BALANCE: THE ROLE OF RADIATION **c47**
R. Kandel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 100-114 (For primary document see N92-22826 13-42)
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The role of radiation, cloud radiation interactions in the climate, and radiation processes in climate change are discussed. The geometrical constraints, calibration issues, and time sampling issues of measuring radiation fluxes, done from space, are considered. Radiation parameters to be measured, including solar radiation, reflected SW flux, emitted LW flux, and cloud radiation forcing, are discussed. Radiative fluxes at the sea surface and in the atmosphere are considered. Projected and necessary spaceborne instrumentation for the next twenty years is considered. ESA

N92-22839# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
AIR-SEA INTERACTION **c48**
K. Hasselmann *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 115-118 Original contains color illustrations (For primary document see N92-22826 13-42)
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Since the atmosphere and the ocean are the two most important parts of the climate system, it is expected that a major thrust in climate research will be directed in the future towards a better understanding and modeling of the coupled ocean-atmosphere system. This coupling occurs at the air/sea interface. In the large scale, the two systems interact by means of the fluxes of solar and infrared radiation and by exchange of momentum, latent and sensible heat, and fresh water (precipitation minus evaporation). On the smaller scale, these fluxes are governed by complex turbulent interaction processes at the moving sea surface. They can be determined reliably only through a proper understanding of the dynamics of the interface and the interactions of the turbulent atmospheric and oceanic boundary layers in which it is embedded. Air sea fluxes are normally represented in large scale ocean, atmosphere or coupled models by highly simplified bulk formulae. Improved descriptions of these fluxes are looked for; the benefits that these would have for climate studies are stated. A table of the sea surface and near sea surface variables

that can be measured from space is presented. Reasons for implementing an end to end data assimilation system, including sensor algorithms, data quality control, first guess forecasts, and model initialization are given. ESA

N92-22840# Reading Univ. (England). Unit for Thematic Information Systems.
LAND-SURFACE PROCESSES: INTRODUCTION c45
J. Gurney *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 119-122 (For primary document see N92-22826 13-42)
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The study of the land surface as part of the climate system is important because of the role it plays in radiation interception, partitioning of energy and water fluxes, and because it is part of the climate system with the best and most established data records. The land surface is also important for economic reasons because of the impact of possible changes in climate. A summary of radiation and energy budget studies for climate purposes is given, from which the following conclusions are drawn: simultaneous nadir and off nadir observations are needed at visible and near infrared wavelengths to characterize bidirectional reflectance distribution functions, with simultaneous observations for atmospheric correction; a higher spectral resolution thermal infrared radiometer is needed to make atmospheric moisture and temperature observations, but also to make estimates of surface emittance and temperature; passive microwave observations at 1.4 GHz are needed to estimate near surface soil moisture; passive microwave observations at approximately 18 and 37 GHz are needed estimate snow volume; simple visible and near infrared spectral observations at a few wavelengths are needed to map vegetation, with simultaneous atmospheric correction being required; experiments to study scaling up of energy budget relationships to large spatial scale are required for definition of satellite radiometer requirements as well as for algorithm development. ESA

N92-22841# Alfred-Wegener-Inst. for Polar Research, Bremerhaven (Germany, F.R.).
ICE PROCESSES: INTRODUCTION c45
E. Augustein, P. Lemke, and T. Viehoff *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 123-129 Original contains color illustrations (For primary document see N92-22826 13-42)
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Th effects of sea ice, ice shelves and the polar ice sheets are treated. The parameters that need to be measured in order to determine the effects of ice process on the environment and climate change are listed. The measuring instruments required are also listed. These include spaceborne, airborne and ground based instruments together with those in the oceanic water column. It is revealed that various techniques must be applied in order to determine the surface heat and radiation balances in the polar regions. In the framework of the various observation methods, satellite remote sensing occupies a rather important role which may grow in the future when more refined instruments can be applied to space platforms. ESA

N92-22842# Arbeitsgemeinschaft der Grossforschungseinrichtung, Bonn (Germany, F.R.).
RESOURCE MANAGEMENT: INTRODUCTION c43
J. Bodechtel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 133-135 Original contains color illustrations (For primary document see N92-22826 13-42)
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The need for improvement in the present understanding of the dynamic interactions between man and his resources, and man's impact on the Earth's environment, is stressed. How space remote sensing techniques will constitute an essential information source is discussed. The major advantages of Earth observation from Space are given. The ability of satellites to provide repetitive and continuous data, on a regional and global basis is considered most advantageous. A summary of the requirements to guarantee optimum use of spaceborne remote sensing for resource management is given. The development of technology from experimental sensors to operational and future missions is shown, and the step by step approach from qualitative interpretation to quantitative evaluation is emphasized. ESA

N92-22843# Joint Research Centre of the European Communities, Ispra (Italy). Inst. for Remote Sensing Applications.
RENEWABLE RESOURCES: AGRICULTURE. INTRODUCTION c43
J. Meyer-Roux and T. LeToan (Centre d'Etude Spatiale des Rayonnements, Toulouse, France) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 136-147 Original contains color illustrations (For primary document see N92-22826 13-42)
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Agriculture, together with forestry, is a significant factor in land monitoring and thus to the environment. Satellite data has already made significant contributions to the monitoring of agriculture, land use, planning, cartography, and meteorological forecasting. Basic requirements necessary to make possible direct contributions from satellite data to crop inventories and monitoring are given. It is stated that in addition to mapping, the next ten years should see breakthroughs in control of crops at the field level and in agricultural monitoring, which has often been attempted, but has not proved entirely successful. Current high and low resolution satellite data and their limitations are discussed together with the benefits of all-weather imaging radars. The requirements for future spaceborne missions intended for agricultural purposes are given. These include reliable temporal coverage, adequate spatial resolution, and the combination of optical radiometers and radars. The physical quantities to be measured in order to meet the agricultural objectives and the corresponding measurement requirements are given. ESA

N92-22844# Zurich Univ. (Switzerland).
WATER RESOURCES, SNOW AND ICE: INTRODUCTION c43
H. Haefner and H. Rott (Innsbruck Univ., Austria) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 148-160 (For primary document see N92-22826 13-42)
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Water resources and hydrological quantities in their local, regional and global aspects represent key applications in our present ecological and economic environment. Many remote sensing methods have been developed which indicate clearly their possibilities for an operational application. Nevertheless, their transference into a long term operational system has not yet been realized in Europe. The most advanced and most promising applications exist in the field of snow hydrology for the improvement of power production and fresh water supply. In the fields of surface water and flood monitoring, water quality surveys, soil-moisture monitoring of various spatial scales, and the quantification of areal precipitation, evapotransportation, and remote sensing techniques have also shown considerable potential and are to some extent already used operationally. Substantial research is still needed for a better understanding of the many facets and interactions of the hydrological cycle and for better management and protection of water resources. Significant contributions to these tasks can be expected from advanced Earth observation systems meeting the stringent requirements for water resources management in terms of temporal and spatial resolution. ESA

N92-22845# Joint Research Centre of the European Communities, Ispra (Italy). Inst. for Remote Sensing Applications.
FORESTRY: ENVIRONMENTAL ASPECTS c43
J.-P. Malingreau and P. Reichert (Food and Agriculture Organization of the United Nations, Rome, Italy) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991

p 161-172 (For primary document see N92-22826 13-42)
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The role of the forest not only as a source of timber but also as a major component of the Earth system is now recognized. Appropriate tools are needed to examine the forest canopy at levels which range from global to local, with respect to a variety of land and ecosystem parameters, and in observation modes which range from a single inventory to a near continuous monitoring system. Details of the scales of surveys and the resolution of instruments used at the local, regional and global levels are discussed. Needs in vegetational forest surveys are varied and the definition of a common package is not straightforward. A list of categories of vegetation related parameters which must be taken into consideration is given including stand, ecosystem, site characteristics, and biomass burning. Current satellite contributions and their limitations are considered. The physical quantities which must be measured in order to meet the objectives for forestry applications are considered together with the measuring requirements. ESA

N92-22846# Arbeitsgemeinschaft der Grossforschungseinrichtung, Bonn (Germany, F.R.).
NON-RENEWABLE RESOURCES **c43**
J. Bodechtel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 173-180 (For primary document see N92-22826 13-42)
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Remote sensing is an important tool within many geoscientifc disciplines. The prime aim is to apply satellite remote sensing methods operationally in the exploration of metallic and non metallic mineral resources and hydrocarbon deposits, in engineering geology, in ground water supply studies and in geological hazard assessment, such as the surveillance of volcanic activity and erosion and earthquake damage. Nonrenewable resource applications of remote sensing are listed. The physical properties to be measured in order to meet the objectives for non renewable resource applications are listed together with the soil and rock, and vegetation parameters. The development of Earth observing sensors for non renewable sources is tabulated. The advantages of microwave remote sensing are discussed. Possible contributions of space techniques and recommendations for spaceborne instrumentation are discussed. ESA

N92-22847# Ludwig-Maximilians-Univ., Munich (Germany, F.R.). Inst. fuer Meteorologie.
LAND TRANSFORMATION, LAND USE AND CARTOGRAPHY: LAND-SURFACE TRANSFORMATION PROCESSES **c43**
H. J. Bolle *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 181-192 (For primary document see N92-22826 13-42)
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The need for global data sets derived from observations in space is clearly apparent. Attempts have been made on a more or less experimental basis to compile global data sets which are generally not validated to the degree necessary to meet the very stringent specifications for global change studies. The production of these data sets needs to be confirmed, but with a more solid basis that guarantees continuity in time, validation, permanent quality control and easy accessibility. Steps that would help to reach this goal range from workshops (to compare and select algorithms), to mesoscale field experiments (to validate the information derived from the data), the establishment of research centers dealing with the controlled production and documentation of the final products. The International Geosphere Biosphere Program (IGBP) provides the framework for the very substantial effort that is necessary to reach this goal, and Europe should participate at an early stage at a level appropriate to its high scientific standards. ESA

N92-22848# University Coll., London (England).
CARTOGRAPHY: CURRENT REQUIREMENTS FOR TOPOGRAPHIC MAPPING **c43**
I. Dowman *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 193-195 (For primary document see N92-22826 13-42)
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Requirements for cartography and topographic mapping are summarized. These include: map compilation, map revision, detection of change in cultural features such as buildings and communications, production of image maps for input to a Global Information System (GIS) or for general use, and production of Digital Elevation Models (DEMs) on a global scale. In order to fulfill these requirements by photographic means, data is required of large areas - the whole land surface of the globe in the case of DEMs. Satellite borne sensors and systems such as SPOT and photographic cameras are considered as means of obtaining data. A complete package of sensors and ground processors for topographic mapping is given. This includes an optical sensor; an imaging Synthetic Aperture Radar (SAR); a narrow beam scanning radar altimeter; a Global Positioning System (GPS), PRARE or DORIS type system to provide satellite position; and ground processing providing automatic fixing of sensor position and attitude, automatic DEM extraction, and automatic geocoding. ESA

N92-22849# Maryland Univ., College Park.
LAND USE PLANNING: INTRODUCTION **c43**
J. Townshend *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 196-206 (For primary document see N92-22826 13-42)
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Requirements for land use information are discussed together with current capabilities of remote sensing in this domain. Requirements for new sources of remotely sensed data are considered, with special attention being given to improvements in optical systems and the application of microwave remote sensing. It is concluded that current remote sensing systems are inadequate for many tasks of land use mapping and monitoring. Technologically feasible improvements, which would greatly increase our capabilities in this area, and which should therefore have high priority in ESA's plans over the next decade, include the following: finer spatial resolutions for both optical and microwave systems; better selection and improved numbers of spectral bands, especially for fine resolution optical systems; better calibration of optical sensing systems, especially those with coarse spatial resolution; and improved microwave systems with multifrequency and/or multipolarizing capabilities. Given ESA's tradition of focussing on sensing rather than the subsequent use of the data, the emphasis was on the sensing systems of the space sector rather than the ground and user segments. ESA

N92-22850# Technische Univ., Delft (Netherlands).
SOLID EARTH: INTRODUCTION **c46**
R. Rummel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 209-213 Original contains color illustrations (For primary document see N92-22826 13-42)
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The principles of the solid Earth program are introduced. When considering the study of solid Earth from space, satellites are used as beacons, inertial references, free fall probes and carrying platforms. The phenomenon measured by these satellites and the processes which can be studied as a result of these measurements are tabulated. The NASA solid Earth program focusses on research into surface kinematics, Earth rotation, land, ice, and ocean monitoring. The ESA solid Earth program identifies as its priority the Aristoteles mission for determining the gravity and magnetic field globally, with high spatial resolution and high accuracy. The Aristoteles mission characteristics and goals are listed. The benefits of the improved gravity information that will be provided by this

mission are highlighted. This information will help in the following research: geodesy, orbit mechanics, geodynamics, oceanography, climate sea level, and the atmosphere. ESA

N92-22851# Technische Univ., Delft (Netherlands).
SOLID EARTH FROM SPACE: GRAVITY FIELD, MARINE GEOID AND PRECISE POSITIONING. INTRODUCTION **c43**
R. Rummel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 214-219 (For primary document see N92-22826 13-42)
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The ESA solid Earth program is considered. The necessity of research from space is discussed. The priorities of the solid Earth program of NASA (Earth's rotation, plate and intraplate tectonics) and the ESA (geopotential fields, and oceanic circulation and climate changes) are presented. The scientific rationale behind the following are considered: geopotential field, geodesy, geodynamics, oceanography, sea level rise and climatology, time variations of gravity field, and ice/ocean/land surface monitoring. The highest priority of the ESA short term is the improvement on current knowledge of the global geopotential fields, gravity and magnetism. This will be achieved by the Aristoteles mission of which details are given. The medium term program is directed towards the development of new sensors required for improved: global geopotential determination, determination of its variations with time, and monitoring of ocean/ice/land surface dynamics. The latter are discussed. ESA

N92-22852# Bologna Univ. (Italy).
EARTH PHYSICS: STATE-OF-THE-ART AND MAIN ISSUES **c46**
S. Zerbini *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 220-225 (For primary document see N92-22826 13-42)
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The state of the art and main issues concerning Earth physics are discussed. Many geophysical processes result from the interaction of the various parts of the Earth system, the solid Earth, the atmosphere, the oceans, the liquid core and the solid inner core which exchange energy and angular momentum among themselves. Study of these phenomena on a global or on a local scale provides substantial insight into the properties of the Earth itself. The phenomena associated with the geoid are the rotation about its axis of spin (or its time derivative), the polar motion (mutation and precession), tides, temporal variations in its mass distribution, and its geopotential. These are caused by the deformation of the solid Earth and by the exchanges of angular momentum both between the solid and fluid parts with extraterrestrial bodies. Space geodesy will contribute in a substantial way to understanding of the long term dynamics of the Earth, such as the relative motions between the major tectonic plates, the deformation in active tectonic zones and stress accumulation and release on large faults. The possible contribution of space techniques to research in this field is discussed and recommendations for spaceborne instrumentation are given. ESA

N92-22853# Paris VI Univ. (France). Inst. de Physique du Globe.
MAGNETIC FIELD **c46**
J. Achache *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 226-239 (For primary document see N92-22826 13-42)
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The evolution of the environment at the surface of the Earth is inherently coupled with processes and forces taking place below this surface, sometimes on the very deep interior of the planet. Very few tools are available to probe that interior. The analysis of natural variations in space and time of the Earth's magnetic field, one of the most pervasive phenomena on the Earth, is one of them. Three sources contribute to the magnetic field near the Earth's surface: electric currents in the core, magnetization in the upper lithosphere and electric currents outside the Earth, together with their induced counterparts on the inside. The study of the geomagnetic field will thus have a substantial impact on the degree of understanding of the processes taking place in the Earth's interior by providing an insight into every single layer of the planet. Current knowledge of the following is reviewed: the dynamics of the Earth's deep interior; the Earth rotation, polar motion and core mantle coupling; the structure of the continental lithosphere and evolution of continents; and earthquake prediction. Parameters to be measured through space techniques include the secular variation, external field variations, lithospheric anomaly field, and electromagnetic variations of seismic and volcanic origin. The contribution given by space techniques and recommendations for spaceborne instrumentation are discussed. ESA

N92-22854# Paris VI Univ. (France).
CONTRIBUTIONS TO CLIMATE RESEARCH: STUDY OF THE SOLID EARTH IS OF IMPORTANCE TO CLIMATE RESEARCH IN THREE AREAS **c47**
J.-F. Minster *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 240-241 (For primary document see N92-22826 13-42)
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The study of the solid Earth is of importance to climate research in three areas: determination of the Earth's potential field; polar motion and Earth rotation; and absolute mean sea level rise. Each of these are discussed. ESA

N92-22855# Italian Meteorological Service, Rome.
METEOROLOGY: INTRODUCTION **c47**
B. Bizzarri *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 245-247 Original contains color illustrations (For primary document see N92-22826 13-42)
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Apart from weather forecasting meteorology encompases climatology and environmental monitoring. Direct involvement in the application of meteorology to hydrological, agricultural and marine activities has become the norm. To illustrate this the distribution of resources among the various programs of the World Meteorology Organization (WMO) is shown. The requirements of space observations in meteorology are discussed; and the general requirements of the space based subsystem of the Global Observing System is outlined. ESA

N92-22856# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
OPERATIONAL METEOROLOGY: GENERAL OVERVIEW **c47**
J. Morgan *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 248-255 (For primary document see N92-22826 13-42)
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A general overview of operational meteorology is given with the role of Europe being considered. The required parameters and the role of observations from space are discussed, together with the instruments required for operational meteorology. The priorities of the operational meteorology community are as follows: over the near-term, to continue and improve the present complement of instruments in both polar and geostationary orbit, which are essential for operational meteorology and provide essential data for research and many other disciplines on a series of satellites to be launched as required to ensure data continuity; over the medium term, to make significant improvements in global temperature sounding, to develop an improved geostationary imaging system, to gain practical experience in experimental missions now being developed; over the longer term, to encourage the development of instruments for the measurement of atmospheric winds and for precipitation estimates. ESA

N92-22857# GKSS-Forschungszentrum Geesthacht (Germany, F.R.).
RADIATION AND CLOUDS **c47**
E. Raschke *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 256-259 (For primary document see N92-22826 13-42)
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Energy fluxes caused by electromagnetic shortwave and longwave radiation of solar and terrestrial origin, respectively, drive and feel many processes in the atmosphere, both at the continental surfaces and in the ocean. In the atmosphere they are primarily modified by cloud fields, which themselves transport latent heat and provide most of the precipitation reaching the ground. Clouds are also the loci of many heterogeneous chemical reactions. Research underway in this domain is outlined, and requirements for operational meteorology are summarized. The following research is considered: radiative transfer within the cloudy atmosphere; radiation budget at the top of the atmosphere; and radiation budget at ground level. Requirements to measure radiation budget components are outlined. ESA

N92-22858# Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
CONVECTION AND PRECIPITATION: MOISTURE CONVECTION AND METEOROLOGY **c47**
J. Testud *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 260-263 (For primary document see N92-22826 13-42)
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The role of moisture convection in meteorology is considered. Because it involves small scale or mesoscale processes, moisture convection is not explicitly represented in numerical models. It nevertheless has a major impact on the dynamics of the atmosphere on a large scale and is of major interest for weather forecasting. Different types of moisture convection are discussed: shallow cumulus convection, precipitating moisture convection, deep conventional and mid latitude frontal convection. Future actions to propose numerical forecasting are proposed including parametrization schemes for deep convection, and explicit representation of mesoscale convection. The long term prospect of a spaceborne Doppler radar for the monitoring of moisture convection on a global scale is discussed at length. ESA

N92-22859# Meteorological Office, Bracknell (England).
SURFACE/ATMOSPHERE INTERACTIONS: INTRODUCTION **c47**
P. Mason *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 264-269 (For primary document see N92-22826 13-42)
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Satellite data have a vital role to play in specifying surface/atmosphere interactions for operational meteorology. The surface state is particularly important, and for such data the critical need is to seek operational security of existing instruments and further measurements suitable for cloud conditions. Information about the lower region of the atmosphere close to the surface is also essential in order to allow weather forecasts to achieve their full potential, but it is not yet readily available. Research should be undertaken to develop instruments to obtain such information. Requirements for two dimensional surface measurements, and for boundary layer measurements are tabulated, together with instruments that are able to provide surface parameters and boundary layer parameters. ESA

N92-22860# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
IMPROVED OBSERVATIONAL REQUIREMENTS FOR MODELLING: IMPROVEMENT OF NUMERICAL WEATHER PREDICTION **c47**
L. Bengtsson *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 270-273 (For primary document see N92-22826 13-42)
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Numerical weather prediction is an initial value problem. The quality of a forecast is directly related to the accuracy of the initial state and the accuracy of the model. During the last forty years, numerical modeling has undergone enormous development due to the improvement of the observing system, improvement in modeling, and the massive development of computers. Further development is feared to be coming to a halt due to the poor quality of the data from the space observing systems. The need of improvement here is stressed. Of particular importance are more accurate wind and temperature observations throughout the depth of the atmosphere. Other priorities in developing future observing systems are discussed. ESA

N92-22861# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
ANNEX A: REQUIREMENTS FOR POLAR ORBIT **c18**
J. Morgan *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 274-279 (For primary document see N92-22826 13-42)
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The system configuration principles and data requirements needed for meteorological satellites in polar orbit are specified in general terms. The orbital requirements and those on data availability are specified, and the principles for data management at local and global level are outlined. ESA

N92-22862# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
ANNEX B: LONG-TERM DEVELOPMENTS FOR OPERATIONAL METEOROLOGY **c47**
J. Morgan *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 280-282 (For primary document see N92-22826 13-42)
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A high level World Meteorological Organization (WMO) statement of general requirements for the space based subsystem of the Global Observing System is presented. Requirements which could be met by feasible new developments are defined. These include the necessity to observe the complete three dimensional wind field on a global basis throughout the troposphere and stratosphere; improved estimation of precipitation, particularly over the ocean; atmospheric discontinuities and cloud top height; and surface pressure. Future geostationary systems are considered. ESA

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-22126# Alberta Forestry, Lands and Wildlife, Edmonton. Land Information Services Div.
AN ANALYSIS OF HABITAT CHANGE IN THE COUNTY OF MINBURN USING LANDSAT MSS AND TM DIGITAL DATA
Dennis OLeary, Arnold Hougham, Sandra Gabrielson, and Tim Perrot 1990 24 p
(ISBN-0-86499-703-5; CTN-91-60096) Copyright Avail: NTIS HC/MF A03

A pilot project to determine the feasibility and applicability of utilizing digital LANDSAT data to classify habitat types and determine habitat change at a 1:100 000 scale is described. The county of Minburn, Alberta was selected as a test area in which to apply the digital classification techniques. LANDSAT

multispectral scanner (MSS) and thematic mapper (TM) data was obtained for the county of Minburn. The MSS data was acquired May 1977, while the TM data was from May 1987. Early season imagery was acquired because it was felt that it would be easier to distinguish the agriculture/grassland cover type from the forest, shrubland, wetland, and water types. Both data sets were resampled to 50 m pixel size so as to allow for a more accurate estimate of change. Both data sets were co-registered and referenced to a universal transverse mercator projection using ground control points identified on a 1:50,000 map. Accuracy assessments indicate that the forest, agriculture/grassland, and water classes were all classified to above 85 persent accuracy. The wetland and shrub classes were somewhat less, ranging between 65 and 70 percent, respectively. It was necessary to circumvent the normal classification process in order to successfully identify some areas, including towns, wetland, and cloud shadowed areas. The original classification misclassified some areas where pixels had mixed signatures. The MSS data underclassified the amount of forest present and the TM data overclassified it. This problem was corrected by adding forest pixels to the MSS classification and removing some from the TS classification.

Author (CISTI)

N92-22153# Lockheed Engineering and Sciences Co., Las Vegas, NV.

WATERSHED CHARACTERIZATION USING LANDSAT THEMATIC MAPPER IMAGERY: BLACKFOOT RIVER, MONTANA

K. H. Lee Dec. 1991 34 p
(Contract EPA-68-CO-0050)
(PB92-115237; EPA/600/4-91/027) Avail: NTIS HC/MF A03
CSCL 08H

Described here is a portion of a large regional project undertaken by the Environmental Protection Agency (EPA) and water quality authorities in the states of Montana, Idaho, and Washington to identify and analyze factors which are affecting water quality in the Lake Pend Oreille hydrologic system. To achieve this directive in Montana, a spatial database is being constructed which will contain satellite derived land cover, photo-interpreted macrophyte locations, and data from other sources for climate, topography, hydrography, and soils. The database will be used by EPA Environmental Monitoring Systems Laboratory-Las Vegas to demonstrate the utility of a watershed scale information management system. The information management system is geared toward nonpoint pollution modeling and will evolve into a decision support mechanism capable of assessing the suitability and feasibility of various management scenarios (James and Hewitt, 1990). The data layers focus on the elements required for nonprint source pollution modeling in which derivation of factors for soil erodability, rainfall, topographic slope-length, and vegetation management are generated for the watershed. The vegetation management factor will be partly based on land cover derived from LANDSAT Thematic Mapper satellite imagery. Vegetative management factors combine vegetative cover and soil surface conditions into one numerical factor. Only the generation of land cover for the Blackfoot River Watershed is addressed through quantitative remote sensing techniques. Author

N92-22866# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS OF THE SECOND SYMPOSIUM ON MOS-1 VERIFICATION PROGRAM

Hideo Satoh, ed. and Korehiro Maeda, ed. Dec. 1988 506 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 12-14 Jul. 1988
(JTN-92-80304) Avail: NTIS HC/MF A22

The following topics were discussed: Marine Observation Satellite-1 (MOS-1), earth observation, satellite observation, satellite imagery, sea survey, infrared radiometers, microwave radiometers, visible radiometers, Visible and Thermal Infrared Radiometer, Microwave Scanning Radiometer, Multispectral Electronic Self-Scanning Radiometer, Data Collection System, ocean data acquisitions systems, earth surface observation, vegetation identification, timber identification, snow cover observation, rain rate observation, sea ice observation, atmospheric correction, geometrical correction, image analysis, image reconstruction, noise analysis of radiometer, radiometric characteristics, reception of MOS-1 data, cloud parameters, atmospheric parameters, sea surface temperature. For individual titles, see N92-22867 through N92-22917.

N92-22867# National Space Development Agency, Tokyo (Japan).

OUTLINE OF MOS-1 MISSION EVALUATION

Hiroshi Horiguchi and Yukie Iida *In its* Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 1-9 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

This paper summarizes the result of the evaluation of Marine Observation Satellite-1 (MOS-1) orbital performance. The evaluation covered the performance of the satellite hardware since the launch through the operational phase in orbit. MOS-1 is Japan's first medium altitude experimental earth observation satellite developed for establishing the nation's earth observation technology. The satellite was launched successfully from Tanegashima Space Center, NASDA (National Space Development Agency of Japan), by the N-2 Launch Vehicle on February 19, 1987. After one day in the orbit, it acquired earth-oriented normal attitude. During the succeeding three months, the orbital performance of the mission and bus equipment was thoroughly checked out. The result of this checkout showed the satellite performance to be generally satisfactory. Since the beginning of the routine satellite operation, MOS-1 has operated fairly well. There is no component failure yet and performance degradation of life-limited components is within the expected range. Regardless of the seasonal change of space environment, thermal and attitude telemetries has been maintained in small deviations. Up to now in satellite orbital operation, some minor problems were found, including the false execution of delayed command caused by Single Event Upset (SEU) of the command memory, and safety attitude retraction due to malfunction of the earth sensor.

Author (NASDA)

N92-22868# National Space Development Agency, Saitama (Japan). Earth Observation Center.

OUTLINE OF MOS-1 MISSION OPERATION

Kohei Arai *In its* Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 10-13 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

In order to determine the Marine Observation Satellite-1 (MOS-1) operation schedule together with monitoring telemetry and mission data, Mission Management Organization (MMO) has been operating since the beginning of the mission check period. This report describes the method for mission operation scheduling and the monitoring of data together with the function of MMO installed at EOC (Earth Observation Center), NASDA (National Space Development Agency of Japan). Author (NASDA)

N92-22869# National Space Development Agency, Saitama (Japan). Earth Observation Center.

RESULTS OF MOS-1 VERIFICATION PROGRAM (MVP)

Korehiro Maeda, Hiroyuki Wakabayashi, Masanobu Shimada, and Hideo Satoh *In its* Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 14-25 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Marine Observation Satellite-1 (MOS-1) was successfully launched from Tanegashima Space Center, NASDA (National Space Development Agency of Japan) by N-2 Launch Vehicle on February 19, 1987. The MOS-1 has four mission instruments: (1) Multispectral Electronic Self-Scanning Radiometer (MESSR); (2) Visible and Thermal Infrared Radiometer (VTIR); (3) Microwave Scanning Radiometer (MSR) ; and (4) Data Collection System Transponder (DCST). All mission instruments were found to be satisfactory during the mission check period (three months after

the launch), though there was an interference problem in DCS (Data Collection System) due to the outer radio interference source which was resolved by changing the frequency of Data Collection Platform (DCP). NASDA planned and initiated the MOS-1 Verification Program (MVP) to evaluate the MOS-1 observation system since March 1987. NASDA is conducting MVP in collaboration with the joint research organizations, domestic and foreign organizations. As a part of the MVP, NASDA conducted airborne experiments in summer and winter in several test sites in FY 1987 in Japan on passing days of MOS-1 and will conduct summer airborne experiments in FY 1988. In this paper, the outline of MVP will be described and some initial results of MVP will be presented. Author (NASDA)

N92-22870# National Space Development Agency, Saitama (Japan).
DATA COLLECTION SYSTEM OPERATING ON JAPAN'S FIRST MARINE OBSERVATION SATELLITE: INFLIGHT EVALUATION OF THE SYSTEM PERFORMANCE
Masanobu Shimada, Takashi Yamazaki, Masanobu Tsuji, and Noritaka Tanioka *In its* Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 26-35 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The Marine Observation Satellite-Data Collection System (MOS-DCS) provides the opportunities to monitor the phenomena of the earth surface, with the utilization of the communication technology combined with the satellite in low-polar orbit. The mission objectives of the MOS-DCS are classified into location determination of DCP (Data Collection Platform), making use of the Doppler frequency measurement at ground station, and data communication through the satellite. Its servicing is restricted within the circle of about 5,000 km radius centered at the ground station, so the location accuracy depends not only on the errors concerning the measurement of some engineering parameters, such as Doppler frequency, synchronized time, and so on, but also on where the DCP is located. This paper discusses the location accuracy of the MOS-DCS, regarding the originated DCP location within its servicing area and some correction parameters, combined with some results of experiments and simulations. Moreover, it deals with the communication performance of the MOS-DCS. Author (NASDA)

N92-22871*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PRELIMINARY RESULTS OF MOS-1 MSR, VTIR, AND MESSR DATA QUALITY EVALUATIONS AT NASA Abstract Only
Roy W. Spencer, Gary J. Jedlovec, and Robert J. Atkinson *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 36-37 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

A preliminary evaluation of the Microwave Scanning Radiometer (MSR), the Visible and Thermal Infrared Radiometer (VTIR) and the Multispectral Electronic Self-Scanning Radiometer (MESSR) on the Marine Observation Satellite (MOS-1) has been performed. Data from these instruments have been analyzed using image processing systems at NASA's Marshall Space Flight Center (MSFC). Analysis of the MOS-1 orbital parameters and the MSR, VTIR, and MESSR scan geometries allow the use of software developed for the Man-computer Interactive Data Access System (McIDAS) at MSFC to navigate and re-map these data into different projections and to display it with other data bases at the same time. These data quality evaluations are preliminary and are based on a limited number of scenes. The goals of the evaluation are quite general but serve to address the basic quality of the data and its usefulness in deriving data products for case study investigations. The following goals have been partially addressed to date and will be further addressed later in this investigation: (1) Evaluate the general quality of the MSR, VTIR and MESSR data and their application to multi disciplinary investigations; (2) Determine the noise characteristics of the MSR and VTIR thermal channels, and compare these noise estimates and the radiometric accuracy to that of similar U.S. satellite imaging instruments; (3) Investigate the calibration accuracy of the MESSR data with respect to the use of the large linear array of detectors; (4) Study the usefulness of the high resolution water vapor measurements from the VTIR in understanding mesoscale atmospheric processes.
Author (NASDA)

N92-22872# European Space Agency. ESRIN, Frascati (Italy). Earthnet Program Office.
PROGRESS REPORT ON MOS-1 VERIFICATION. PROGRESS REPORT ON EUROPEAN MOS-1 DATA UTILISATION PROGRAMME (EMDUP)
Luigi Fusco and Marianne Egleme *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 38-59 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

One data set was received from NASDA (National Space Development Agency of Japan) and it was analyzed in order to gain familiariety with the MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) data. The ESA (European Space Agency) MVP (Marine Observation Satellite-1 Verification Program) participation is based on the analysis of the European MOS-1 (Marine Observation Satellite-1) acquisitions and processing performed at Earthnet stations. ESA has been acquiring MOS-1 data in four stations since November 1987, but at present ESA has not yet generated MESSR and VTIR user products. The participation of the MVP and the anticipated support to other investigators is still on stand-by. The European MOS-1 Data Utilization Program (EMDUP) was defined in 1987 by the Earthnet Program Office to promote the utilization of MOS-1 data acquired in Europe. The number of MOS-1 products presently requested (or specified) by PIs are: 266 MESSR, 110 VTIR and 83 Microwave Scanning Radiometer (MSR) scenes. Author (NASDA)

N92-22873# National Research Council, Bangkok (Thailand).
THE CURRENT STATUS OF MOS-1 ACTIVITY IN NRCT
Choompol Swasdiyakorn and Chanchai Peanvijarnpong *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 60-68 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Since the exchange of a verbal note on December 11, 1986, the governments of Thailand and Japan have been cooperating on the MOS-1 (Marine Observation Satellite-1) Project, which has two components: (1) co-operation on direct reception from MOS-1 satellite; and (2) joint research in the areas of remote sensing technology and applications of MOS-1 and other available data. The National Research Council of Thailand (NRCT), has carried on the project with the National Remote Sensing Coordinating Committee. The TMS (Thailand MOS-1 Station) under the MOS-1 Project is able to receive MOS-1 data of many countries in the South East Asia region. Therefore, the station is beneficial not only to Thailand and Japan, but also to the countries lying within thecoverage zone of the station. Author (NASDA)

N92-22874# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Soil Science Div.
COUNTRY REPORT ON PRESENT STATUS AND PLAN FOR MOS-1 OPERATION WITH EMPHASIS ON AGRICULTURAL APPLICATIONS IN THAILAND Abstract Only
Pongpit Piyapongse *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 69 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The Department of Agriculture has been conducting a joint research project with the National Institute of Agro Environmental Sciences (NIAES) of Japan to enhance the remote sensing application to agricultural production in the central plain of Thailand. The estimation of agricultural production in the central plain, namely rice, maize, sorghum, sugarcane, and other field crops were emphasized. The main objective is to enhance methodology and preparation to use MOS-1 (Marine Observation Satellite-1) data. The measurement of the spectral responses of various economic

crops were done by NIAES radiometer. At present, LANDSAT-5 data were employed in this research, together with NOAA's data for the vegetation index study. The present status of the program is going well. The future plan for the utilization of MOS-1 Project will be a promising one after the completion of the MOS-1 receiving station in Bangkok this year. The future plan is for MOS-1 data to be utilized by the Department of Agriculture in accordance with the following theme: (1) The application of MOS-1 data to estimate agricultural production in the central plain and northeast Thailand; (2) The utilization of MOS-1 data to monitor the coastal resources of Thailand; (3) The application of MOS-1 data to natural hazards for crop damage monitoring; (4) The application of MOS-1 data together with NOAA and METSAT (Meteorological Satellite) for flood prediction; and (5) The application of MOS-1 data to agro-ecological zoning in Thailand. Author (NASDA)

N92-22875# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Remote Sensing and Data Collection Center.
MOS-1 VERIFICATION PROGRAM FOR FORESTRY APPLICATIONS IN THAILAND
Boonchana Klankamsorn and Thongchai Charuppat *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 70-75 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The agreement of participation in the MOS-1 Verification Program was signed on 25 November 1987 by the director general of the Royal Forest Department and the president of the National Space Development Agency of Japan (NASDA). The focus of this program will be on using MOS-1 data for the classification of forest land into forest, non-forest, shifting cultivation, and forest types in four selected areas of Thailand. Unfortunately, to date, the Royal Forest Department has not received MOS-1 data from NASDA, but will receive the data around September 1988. The verification program will start in October 1988. The verification results of this program will be presented at the Third Symposium in February 1989. Author (NASDA)

N92-22876# National Aerospace Lab., Tokyo (Japan).
STUDY ON THE ESTIMATION TECHNIQUES OF SPATIAL RESOLUTION CHARACTERISTICS FOR THE MESSR Interim Report
Hajime Koshiishi, Masao Naka, and Kohzo Homma *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 76-81 Prepared in cooperation with National Space Development Agency, Japan (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

This is an interim report on the research into the application of estimation techniques to the spatial resolution characteristics of an image sensor. A system parameter of interest is the estimation of spatial resolution characteristics of optical imaging sensors such as MESSR (Multispectral Electronic Self-Scanning Radiometer) after launch. In MOS-1 (Marine Observation Satellite-1) Verification Program (MVP), the computational techniques for estimating spatial resolution characteristics of satellite-based optical imaging sensor systems have been studied. Two techniques for estimating overall spatial resolution characteristics of image sensor system have been investigated; the frequency domain method (Fourier transformation) and spatial domain method (spatial convolution). Several factors affecting in estimation accuracy of the spatial resolution are investigated by using computational simulations. This paper presents an outline of the estimation methods of PSF (Point Spread Function) and MTF (Modulation Transfer Function) of an image sensor system, an analysis of effects by relative motion between platform (satellite) and ground scene, and some results of the estimation experiments for the PSF and MTF characteristics of MESSR using MOS-1 CCT (Computer Compatible Tape) data.
Author (NASDA)

N92-22877# Meteorological Research Inst., Tsukuba (Japan). Meteorological Satellite Observation System Research Div.
INVESTIGATION OF ATMOSPHERIC EFFECT TO MESSR, VTIR AND MSR, AND OBSERVATIONS OF THE OCEANIC PHENOMENA USING MSR
Syoichi Koinuma, Tsutomu Takashima, Yozo Takayama, and Kazuhiko Masuda *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 82-86 Prepared in cooperation with National Space Development Agency, Japan (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The radiation measurement performance of the Visible and Thermal Infrared Radiometer (VTIR) on MOS-1 (Marine Observation Satellite-1) was examined by using simultaneous measurements of sea surface temperature. Observed brightness temperature by VTIR in the clear condition was compared with the brightness temperature calculated theoretically based on measured sea surface temperature and aerological data. For infrared window band (Band 3 and 4), the observed brightness temperatures agreed with the calculated temperature with R.M.S. (Root Mean Square) difference in temperature of 0.94 and 1.18 for Band 3 and 4, respectively. For the water vapor absorption band (Band 2), comparison in brightness temperature between observed and calculated data is difficult, because the radiation is strongly dependent on distribution of water vapor in the middle-to-upper troposphere. However, having a large deviation in temperature difference results shows higher correlation between them. Sea surface temperature obtained in R.M.S. indicated a temperature difference of 0.8 C by using Band 3 and 4 data.
Author (NASDA)

N92-22878# Meteorological Research Inst., Tsukuba (Japan). Oceanographical Research Div.
INVESTIGATION OF ATMOSPHERIC EFFECT ON MESSR, VTIR AND MSR AND OBSERVATIONS OF THE OCEANIC PHENOMENA USING MSR
Akira Shibata, Yoshio Shinohara, Koji Ueno, and Kenzo Shuto *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 87-91 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Japan (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Three geophysical parameters retrieved from the MSR (Microwave Scanning Radiometer) data - accumulated water vapor, accumulated liquid water both over the ocean, and sea ice extent - are compared with the truth data of upper air observations of water vapor at Hachijo Island, the rain rate estimated by the radar located on Mt. Fuji, and a chart of sea ice, respectively. From these comparisons the MSR demonstrates a full performance expected in the planning stage, except for a possibility that the temperature at 23 GHz is higher than a theoretical value by about 5 K. Author (NASDA)

N92-22879# Meteorological Research Inst., Tsukuba (Japan).
ATMOSPHERIC EFFECT ON THE OBSERVED BRIGHTNESS TEMPERATURE [KANSOKU KIDO NI OYOBOSU TAIKI NO EIKYO]
Tadao Aoki, Yoshinari Mizuno, Kung Hwa Wang (Meteorological Satellite Ground Station, Taiwan), Kiyotaka Shibata, Masashi Fukabori, and Teruo Aoki *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 92-95 In JAPANESE Prepared in cooperation with National Space Development Agency, Japan (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

A comparison was made among the observed data from MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) and the calculated data of the Line-by-Line (LBL) Model and the high speed multivariate band model which was recently developed. As a result, the calculated data was systematically smaller than the observed one. The radiative transfer

model in the microwave region was developed, and a comparison of data from this model and MSU (Microwave Sounding Unit) data of TIROS-N (Television Infrared Observation Satellite-N) satellites showed systematical differences in data among satellites.
Author (NASDA)

N92-22880# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
EVALUATION OF THE MSR ANTENNA PATTERN AND RETRIEVAL ERROR OF WATER VAPOR CONTENT
Takeyuki Ojima, Hiroshi Kuroiwa, Hideo Satoh, and Korehiro Maeda *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 96-102 Prepared in cooperation with National Space Development Agency, Japan (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Data processing of 20 scenes of the MSR (Microwave Scanning Radiometer) aboard MOS-1 (Marine Observation Satellite-1) has been made until now. One scene of them is for the evaluation of MSR antenna pattern and the influence of land radiation on antenna temperature was found to remain as far as about 600 km and 500 km from land at 23.8 GHz and 31.4 GHz, respectively. The other scenes were used for validation of retrieved water vapor content. The water vapor contents retrieved from MSR antenna temperatures were compared with the water vapor contents calculated from the radiosonde data at Chichijima and Minami Daitojima under a fine weather condition. As the result, the discrepancy between the retrieved and calculated ones was found throughout all data and every season. The MSR derived water vapor contents were always larger than the calculated ones by about 10 kg/sq m. The comparison between MSR antenna temperature and the brightness temperature calculated from radiosonde data was also made at 23.8 GHz and 31.4 GHz. The antenna temperatures measured at 23.8 GHz were larger than the calculated brightness temperatures. The causes of these discrepancies may be considered as follows: (1) the error of antenna pattern correction; (2) the increase of brightness temperature due to surface roughness of the sea; (3) the error of theoretical atmospheric attenuation; (4) measurement errors of the MSR; and (5) the time difference between the MSR and radiosonde observations. Author (NASDA)

N92-22881# Tokai Univ., Tokyo (Japan). Research and Information Center.
ESTIMATION OF MTF OF MOS-1 MESSR IMAGES
Toshibumi Sakata, Haruhisa Shimoda, and Kiyonari Fukue *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 103-114 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Japan (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

An MTF (Modulation Transfer Function) of MESSR (Multispectral Electronic Self-Scanning Radiometer) image was estimated using an edge spectrum ratio method. This method is based on the Fourier spectrum amplitude ratio between the real and an ideal edge through a Hanning window. This method was applied to vertical and horizontal edges in several MESSR images. As the values of the Effective Instantaneous Field of View (EIFOV), 81 and 67 m were obtained from the estimated MTF for tracking and scanning directions, respectively. Furthermore, the estimated line spread function from the obtained MTFs showed that the half value width are 52 and 46 m for that two directions, respectively.
Author (NASDA)

N92-22882# Tsukuba Univ., Ibaraki (Japan). Inst. of Information Sciences and Electronics.
GEOMETRICAL CORRECTION FOR MOS-1 MESSR AND VTIR IMAGE DATA
Takashi Hoshi, Yoshifumi Sameshima, and Korehiro Maeda (National Space Development Agency, Saitama, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 115-119 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The purpose of this research is to rectify the geometric distortions included in the original image data to enable the analysis using image data of MOS-1 (Marine Observation Satellite-1). The image data used in this research are extracted from MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) loaded on the platform of MOS-1. The data are not rectified yet. The evaluation of the results obtained from this research is carried out from GCP (Ground Control Point) and distance points of view. Author (NASDA)

N92-22883# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION
Masao Takabe, Toshikazu Itabe, and Tadashi Aruga *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 120-130 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

An earth laser beacon is observed from space as a point similar to a bright star. Thus the spot image of laser beacon is very useful for calibration and correction of the earth's surface image taken by optical radiometers or cameras, since it corresponds to an infinitively small land mark which absolute location and brightness are known precisely. The experiments of tracking the MOS-1 (Marine Observation Satellite-1) and transmitting a laser beam from a ground station to the satellite have been conducted. Currently argon ion laser is used as a beacon and images taken by the MESSR (Multispectral Electronic Self-Scanning Radiometer) are analyzed for this study. In the near future, the use of CO2 laser for the VTIR (Visible and Thermal Infrared Radiometer) will be tried. Author (NASDA)

N92-22884# Chiba Univ. (Japan). Remote Sensing and Image Research Center.
INVESTIGATION ON COLOR COMPOSITES OF MESSR, VTIR, AND MSR DATA
Takuji Miwa, Youichi Asahi, and Takasi Ikeda *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 131-139 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The purpose of this report is establishment of a method for suitable expression of MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data on B/W (Black and White) and color photosensitive materials, and selection of useful band combinations, color sequences and transfer functions. In this report, MESSR data of two scenes are used. On the first scene, the suitable band combinations and color sequences are examined using color composites made from B/W negative films which are prepared by NASDA (National Space Development Agency of Japan) EOC (Earth Observation Center). On the second scene, B/W images of MESSR and TM (Thematic Mapper) data are made from CCT (Computer Compatible Tape) using the suitable transfer functions, and the influence to visual interpretation are examined on these images. TM images are made from the averages of four pixels to adjust resolution. It is shown that the histograms of the two scene data are narrow and the images of good gradation suitable for visual interpretation can not be obtained. Author (NASDA)

N92-22885# National Research Center for Disaster Prevention, Tokyo (Japan).
VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR AND VTIR DATA IN THE FIELD OF DISASTER PREVENTION
Shigetsugu Uehara, Shinobu Yazaki, Toshikazu Morohoshi, Shinichi Kishi, Hiroshi Ohkura, and Teiji Kumagai *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec.

1988 p 140-155 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

To verify the effectiveness of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) for classification of various objects, spectral characteristics of MOS-1 MESSR data taken on December 3, 1987 were compared with simultaneously observed airborne MESSR data and ground based spectrometer data in the NRCDP (National Research Center for Disaster Prevention) site area. Due to the great differences in ground resolution and in sensor gain mode, the adequate verification was very difficult. To verify the effectiveness of MOS-1 VTIR (Visible and Thermal Infrared Radiometer) data for the estimation of Sea Surface Temperature (SST), correlation ship between truth SST's and VTIR data on December 2-4, 1987 and January 23, 24, and 28, 1988, were analyzed. Since the number of truth SST data of January is larger than that of December, the analyses were done at first for the data of January and the results obtained were verified for the data of December Through this study, findings are as follows. VTIR Band 3 and 4 data show fairly good correlation ship with truth SST's, but the Band 3 is better than the Band 4. Further, the Band 1 and 2 data also together with the Band 3 and 4 data can be used for more accurate SST estimation. Author (NASDA)

N92-22886# Nihon Univ., Tokyo (Japan). Coll. of Industrial Technology.
A SURVEY ON LANDSLIDES AND VEGETATION IN MOUNTAIN DISTRICTS BY USING MESSR Report No. 2
Hajime Nishikawa, Yasuo Fujii, Shigeru Fukuyama, Takakazu Maruyasu, and Sotaro Tanaka (Remote Sensing Technology Center, Tokyo, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 156-159 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

This paper describes an investigation of vegetation in mountainous district by using MESSR (Multispectral Electronic Self-Scanning Radiometer). The vegetation of Karasugawa River watershed have been investigated by using MESSR data which were obtained on May 31, 1987. And this time was an opportunity to have fine data of Karasugawa River watershed on October 14, 1987. The season of the data was autumn and the false color image shows various color in mountainous area correlated to the condition of vegetation. The condition of vegetation was analyzed and the forest type was classified by image processing using the MOS-1 (Marine Observation Satellite-1) data. Author (NASDA)

N92-22887# Forestry and Forest Products Research Inst., Ibaraki (Japan).
EVALUATION OF MOS DATA FOR FOREST RESOURCE INVENTORY
Haruo Sawada, Yoshio Awaya, Itsuhito Ohnuki, Kazuhiko Kogi, and Fumitoshi Takahashi *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 160-164 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Spectral characteristics of a MESSR (Multispectral Electronic Self-Scanning Radiometer) image were studied through a comparison with a LANDSAT MSS (Multi Spectral Scanner) image. Correlation of digital numbers between two entire images were high in visible channels (0.71 to 0.78) and in infrared channels (0.77 to 0.78). Four principal items of forest (DBH (Diameter at Breast Height), stand height, number of trees/hectare, and volume/hectare) were used for a canonical correlation analysis with MESSR data. By this analysis, infrared channels of MESSR were known to give important data for estimating forest biomass as those of MSS. Two images of VTIR (Visible and Thermal Infrared Radiometer) were overlaid and a simple method for creating a cloud free image was considered. Basic statistical values of the generated image were obtained. Author (NASDA)

N92-22888# Remote Sensing Technology Center, Tokyo (Japan).
VERIFICATION OF RADIOMETRIC CHARACTERISTICS OF MESSR DATA AND VTIR THERMAL INFRARED DATA
Yukio Mukai, Shoji Takeuchi, Kazuo Watanabe, Yasunori Nakayama, Hiroshi Kimura, and Mitsunori Yoshimura *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 165-183 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The following three characteristics were investigated: (1) Radiometric characteristics of MESSR (Multispectral Electronic Self-Scanning Radiometer); (2) Observation characteristics of water surface temperature by VTIR (Visible and Thermal Infrared Radiometer); (3) Land cover classification characteristics of MESSR. As for the radiometric characteristics of MESSR, four kinds of ground targets of different reflectances of bare soil, grass field, asphalt and water were selected. Irradiance and the spectral reflectances of the ground targets were measured at the same time of MOS-1 (Marine Observation Satellite-1) overpass, and the theoretical radiance of the ground targets observed by MESSR were estimated from the ground truth data. On the other hand, the actual radiances of the ground targets observed by MESSR were computed by examining the gray values of the ground targets in MESSR image and transforming them into radiances. Both the theoretical and actual radiances were compared and they were nearly equal in all bands. As for water surface temperatures observation characteristics, VTIR data were compared with NOAA and TM (Thematic Mapper) data obtained on the same day. Water surface temperatures derived from VTIR corresponded pretty well with those derived from NOAA but not with those from TM. As for land cover classification characteristics of MESSR, a test site was selected and a land cover classification images of the test site were produced using MESSR, LANDSAT MSS (Multi Spectral Scanner) and TM data. The land cover classification characteristics of MESSR was investigated by comparing with the classified results by MSS and TM. Author (NASDA)

N92-22889# Tokyo Univ. (Japan). Inst. of Industrial Science.
SNOW OBSERVATION BY MOS-1, MSR AND VTIR
Katumi Musiake and Tosio Koike (Nagaoka Technological Univ., Niigata, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 184-186 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Synchronizing the implementation of the MOS-1 (Marine Observation Satellite-1) Verification Program, ground truth data for MSR (Microwave Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) were obtained around Asahikawa in February 1988. Snow surface temperature, snow depth, and snow density were observed along the route of the aircraft from Mt. Asahidake to Biei and snow depth at 48 sites were collected around Asahikawa. The distribution of the physical characteristics of snow around Asahikawa is identified and it is compared with the data of MSR and VTIR from MOS-1 and the aircraft.
Author (NASDA)

N92-22890# Environmental Research and Technology Inst., Tokyo (Japan).
STUDY ON SNOW HYDROLOGY THROUGH APPLICATION OF MOS-1 SATELLITE DATA
Kenji Ishihara, Tatsuo Izawa, Masaomi Akagawa, Kiyoshi Tsuchiya, Takashi Ishiyama, Masao Matsumoto, Kazuo Watanabe, and Katsutoshi Kozai (Kobe Univ. of Mercantile Marine, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 187-211 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Snow cover in Hokkaido, Japan was studied, using MOS-1 (Marine Observation Satellite-1) satellite data. Starting with the first snow cover on Mt. Daisetsu to Tokachi Mountain range during the pre-snowy season, snow cover in both the mountain range and plain during the snowy season, and snow lines extending

from both sides of the upstream of Ishikari River down to Ishikari Plain during the snow melt season, are detected by MESSR (Multispectral Electronic Self Scanning Radiometer) images. From analysis of MESSR MT (Magnetic Tape) data, it is shown that the seasonal change of the incidence (mW/sq cm/str) at Bands 1 and 4 differ depending upon urban district and vegetation (bamboo grass and pine communities). Analysis of VTIR MT data indicates that the brightness temperature of the snow surface is high along the upstream of Tokachi River in the western and Ribetsu River in the eastern parts and low along Otofuke River in the central part of the MESSR imagery. Finally, from the analysis of MSR (Microwaver Scanning Radiometer) MT date, it is shown that MSR brightness temperature (K) are negatively correlated in shallow snow, while in deep snow there is no correlation between them.
Author (NASDA)

N92-22891# Kyushu Inst. of Tech., Kitakyushu (Japan). Faculty of Computer Science and System Engineering.
OBSERVATION OF DRIFT ICE AND SALT FIELD IN THE LIAODONG BAY, CHINA BY MOS1/MESSR
Sumitoshi Ogata *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 212-219 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

NOAA/AVHRR (Advanced Very High Resolution Radiometer) and MOS-1/MESSR (Marine Observation Satellite-1 Multispectral Electronic Self-Scanning Radiometer) data can be supplementary to each other. In this preliminary test, MESSR data were used to make up for the rough spatial resolution of AVHRR time series data. It has been found that MESSR's spatial resolution is sufficient enough to observe the early stage of drift ice generation and classify salt fields. Author (NASDA)

N92-22892# National Research Center for Disaster Prevention, Hiratsuka (Japan). Branch of Oceanographic Studies.
ESTIMATION OF WAVES AND WINDS OVER SEAS IN THE COASTAL ZONE
Atsushi Takeda, Masayuki Tokuda, Shinichi Iwasaki, Isao Watabe, Toshikazu Morohoshi, and Shinobu Yazaki (National Research Center for Disaster Prevention, Tsukuba, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 220-231 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

A method with which quantitative informations of ocean waves and sea surface winds are obtained from an imagery of visible bands of MESSR (Multispectral Electronic Self-Scanning Radiometer) is discussed. Discrimination of the pattern of individual waves from a MESSR imagery is difficult because of low resolution of 50 m, while it is almost impossible from an image of TM (Thematic Mapper) or SPOT. There is, however, another approach to obtain the informations from a MESSR image. A population density of white caps generated by wave breaking increases with increasing wind speeds. A high density of the white caps over the sea surface will be reflected on the MESSR imagery as a bright spot which can be detected. In fact, a correlation is found between densities of high brightness over a sea area and wind speeds over it. It can be concluded that wind speeds can be estimated from MESSR images with considerations on the fetch and duration. Feasibilities of an wind estimation from MSR (Microwave Scanning Radiometer), which was our first subject, remain unsolved.
Author (NASDA)

N92-22893# Central Research Inst. of Electric Power Industry, Tokyo (Japan).
ADVANCEMENT OF SEA SURVEY AND OBSERVATION TECHNIQUE IN THE SEA AROUND POWER PLANTS
Naoaki Katano, Masafumi Mizutori, Hiromaru Hiraguchi, Kinya Adachi, Michiko Oishi, Shintaro Goto, and Sanae Inamura (Mitsubishi Research Inst., Inc., Tokyo, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 232-248 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Studies were carried out on the estimated physical precision of oceanic observations by an MESSR (Multispectral Electronic Self-Scanning Radiometer) and an MSR (Microwave Scanning Radiometer) mounted on the satellite MOS-1 (Marine Observation Satellite-1). For the MESSR, an analysis was conducted on the results of marine observations in Tokyo Bay synchronized with the satellite and the MSS (Multi Spectral Scanner) data from aircraft, to verify the validity of observations of various water-quality items. As a result, it was recognized that the MESSR Band 2 data was strongly correlated with chlorophyll-a, SS (Suspended Solid) and transparency. Regarding MSR data, an image analysis considering geometric correction, etc. was conducted, and the correlation between the MSR data and the data given by Buoy No. 6 of the Meteorological Agency was discussed. Also, sea-truth concerning waves and sea wind, and wave observation with the X-Band radar were carried out in the coastal area of Niigata Prefecture. The MSR data was more strongly correlated with the amount of water vapor rather than with sea wind and waves. The image of the X-Band radar (10 GHz) was strongly correlated with sea wind.
Author (NASDA)

N92-22894# National Aerospace Lab., Tokyo (Japan).
A STUDY ON INFORMATION ANALYSIS AIDS SYSTEM FOR SEA SURFACE TEMPERATURE MAPS
Hajime Koshiishi, Masao Naka, Hiromichi Yamamoto, Kohtaro Matsumoto, Kohzo Homma, Satsuki Matsumura, Hideo Takahashi, Satoru Nakamura, Hideo Tameishi, and Yoshihiro Okada (Japan Fisheries Information Service Center, Tokyo.) et al *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 249-254 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Oceanic conditions such as fronts, ocean currents, eddies, etc. are very useful for fisheries. For extracting these oceanic conditions, accumulated knowledge and inherited experience are indispensable, and simplified processing and high accuracy of the processed results are important. Technology of knowledge based processing is expected to be applicable to these problems. A feasibility study on information analysis aids for Sea Surface Temperature (SST) image data using this technology was performed. This paper also describes implementation of a prototype knowledge based system. Author (NASDA)

N92-22895# Kanazawa Inst. of Tech. (Japan). Lab. of Information Science.
THE ESTIMATION OF ATMOSPHERIC SCATTERING AND TOPOGRAPHIC EFFECTS ON THE MOS-1 IMAGERY
Yoshiyuki Kawata and Takashi Kusaka *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 255-262 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The main object of this study is to estimate both the atmospheric scattering and topographic effects on the image data measured by the MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer). In this preliminary report, the basic algorithm which converts the measured satellite-level radiance data into the ground albedo data in a flat terrain case are presented. In the analysis, the values of relevant atmospheric parameters such as the optical thickness, the single scattering albedo, and the turbidity factor of the atmosphere were adopted from a model atmosphere given by LOWTRAN 6 code in the evaluation of scattering and transmission functions. Lambert's law was assumed as a bidirectional reflection at the ground surface. Author (NASDA)

N92-22896# National Inst. for Environmental Studies, Tsukuba (Japan).
EVALUATION OF ATMOSPHERIC EFFECT ON MULTISPECTRAL ELECTRONIC SELF-SCANNING RADIOMETER (MESSR) DATA BY SPECTRAL MEASUREMENT

Yoshifumi Yasuoka, Tadakuni Miyazaki, Yasuhiro Sasano, and Sachiko Hayashida *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 263-272 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Atmospheric parameters were estimated by three different methods to evaluate the atmospheric effect on the MESSR (Multispectral Electronic Self-Scanning Radiometer) data. The atmospheric transmittance and the path radiance were estimated from a set of radiance data which are the upwelling radiance measured above water surface and the radiance detected by the MESSR at the corresponding points. Also, the transmittance was estimated from the measurement of direct solar radiation. Further, the transmittance was estimated from the laser radar data.
Author (NASDA)

N92-22897# Institute of Physical and Chemical Research, Saitama (Japan).
RETRIEVAL OF WATER QUALITY PARAMETERS FROM RADIANCE DETECTED BY MESSR
Shigehiko Sugihara and Motoaki Kishino *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 273-278 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

In general, it is rather difficult to estimate the water quality parameters such as the chlorophyll concentration in the surface water from the radiance collected by the MESSR (Multispectral Electronic Self-Scanning Radiometer) of MOS-1 (Marine Observation Satellite-1) since the CCT (Computer Compatible Tape) counts over the water are, in general, too small and path radiance, which has no information on water quality, enters into the sensor. For the water rich in phytoplankton, however, the radiance emerging from below the water surface is large and estimation of chlorophyll concentration might be possible. In order to test the possibility for estimating the water quality parameters in the Lake Kasumigaura from MOS-1 MESSR data, atmospheric transmittance and the sky radiance was observed on October 13, 1987 to estimate the path radiance. After the removal of the path radiance from the MESSR raw data, chlorophyll concentration was estimated.
Author (NASDA)

N92-22898# National Research Inst. for Pollution and Resources, Tokyo (Japan).
EVALUATION OF SPECTRAL RADIANCE OF INLAND SEA WATER IN MOS-1 MESSR IMAGES
Masamitu Onitsuka, Kazuyuki Ohta, and Tsuyoshi Samukawa *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 279-283 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

An extraction method for water color by means of MOS-1 (Marine Observation Satellite-1) data set was studied. This method contained two major parts, the reducing of path radiance from the original data and decomposition from the upward intensities just above the sea surface to x(sub 10), y(sub 10), z(sub 10) components. It was shown that the values of x(sub 10), y(sub 10), z(sub 10) had the error of about 0.02 by standard light source calculations. From the MOS-1 data set, the water color for center part of Tokyo Bay was estimated with the set of values x(sub 10) = 0.29, y(sub 10) = 0.33, z(sub 10) = 0.38 which shown that the MOS-1 data set contained considerable parts of light reflected on the sea surface.
Author (NASDA)

N92-22899# Tohoku Univ., Sendai (Japan). Dept. of Geophysics.
A COMPARISON OF SEA SURFACE TEMPERATURE DETECTED BY MOS-1/VTIR AND FERRIES, ISHIKARI AND OGASAWARA, AND DISCUSSION OF THE RESULTS FROM ASPECTS OF PHYSICAL OCEANOGRAPHY
Hiroshi Kawamura, Kimio Hanawa, and Yoshiaki Toba *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 284-288 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Sea Surface Temperature (SST) observed by MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) Band 3 and 4 (10.5-11.5 and 11.5-12.5 m in wavelength) is compared with in-situ data set of SST obtained by the ferries, Ishikari and Ogasawara. The former shuttles between Nagoya and Tomakomai via Sendai along the Pacific coast of Japan in four days, and the latter shuttles between Tokyo and Ogasawara across the Kuroshio in six days. The Level-2 data of VTIR obtained June 17, 1987 are analyzed and SST of VTIR at positions of the Ishikari around the time of MOS-1 passage are sampled. A brief comparison between SST observed by MOS-1 and by the Ishikari is made. This is the preliminary report of the study for MVP (MOS-1 Verification Program).
Author (NASDA)

N92-22900# Nagasaki Univ. (Japan). Dept. of Civil Engineering.
EXPERIMENT OF ACCURACY OF LANDCOVER CLASSIFICATION AND SEA SURFACE TEMPERATURE ESTIMATION FROM MOS-1 DATA
Keinosuke Gotoh, Masatoshi Mori, Kazuo Kawatate, Masahiro Setojima, and Masatsuna Koga (Japan Weather Association, Tokyo.) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 289-293 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The purpose of this experiment is to check the accuracy of landcover classification and sea surface temperature estimation from MOS-1 (Marine Observation Satellite-1) data. This report deals with the efficiency of both MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) sensors in the sea area. The following two cases are analyzed: (1) to detect the ground water springing into the sea around the Shimabara Peninsula in Kyushu, Japan; and (2) to detect snow water of the Ishikari River flowing into the Ishikari Bay in Hokkaido, Japan. In the latter case, the snow-covered area is also detected in order to check the efficiency of VTIR sensor in the land area.
Author (NASDA)

N92-22901# Toba Merchant Marine Coll. (Japan).
APPLICABILITY OF MESSR AND VTIR DATA FOR MARINE OBSERVATION
Hiroaki Ochiai *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 294-301 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Using the data obtained by MOS-1 (Marine Observation Satellite-1), an attempt was made to evaluate the applicability of remote sensing for marine environment, and the results are as follows: (1) the boundary of river water from Ibi and Kiso River is well defined by the MESSR (Multispectral Electronic Self-Scanning Radiometer) data during the cold season; (2) the water characteristics in the area of red tide recognized by ship's observation in Ise Bay are not well defined by MESSR data in the 1 Jun. 1987 case; and (3) the discontinuous front off the mouth of Ise Bay is well indicated by VTIR (Visible and Thermal Infrared Radiometer) data, especially thermal band imagery on 24 Jul. 1987.
Author (NASDA)

N92-22902# Science Univ. of Tokyo, Chiba (Japan).
MOS-1 DATA BEING ENROLLED IN TO THE KUROSHIO EDDY OBSERVATION SYSTEM
Tsukasa Nishimura, Sotaro Tanaka, Toshiro Sugimura, and Yuji Hatakeyama (Asia Air Survey Co. Ltd., Suita, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 302-312 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

In the first half of 1980, the 'coherent structure of the Kuroshio' was detected by satellite remote sensing. In this experiment, an

attempt was made to use the MOS-1 (Marine Observation Satellite-1) data in the Kuroshio Eddy Observation System, a pilot system. The system design is based on the 'multi-concept', a basic concept of remote sensing. Four types of data are linked and synthesized under the 'coherent structure concept', a deterministic view of the 'turbulence'. Through operation of this pilot system, insight into the mechanics of the dynamic behavior of the coherent structure has been gained, and qualitative estimates of its effects on the Kuroshio variability have been made. The daily monitoring of the 'coherent structure' was determined to be the main task of the operation phase of Kuroshio Eddy Observation System. In this MOS-1 verification experiment, application of the VTIR (Visible and Thermal Infrared Radiometer) data to the daily monitoring of the coherent structure was examined, and the design concept required in the operation phase Marine Observation Satellite is discussed. Author (NASDA)

N92-22903# Science Univ. of Tokyo, Chiba (Japan). Dept. of Civil Engineering.

ADAPTABILITY OF MOS-1 DATA TO VISUALIZATION OF COASTAL HYDRAULIC PHENOMENA

Sotoaki Onishi, Takeharu Ohura, and Jap Tsaren *In* NASDA, Proceedings o˙ the Second Symposium on MOS-1 Verification Program Dec. 1988 p 313-317 (For primary document see N92-22866 13-43)

Avail: NTIS HC/MF A22

Hydraulic behavior of effluents dumped into the Sea of Japan at the northern coast of Honshu Island in Japan from rivers and plants are studied through the satellite remote sensings from the MOS-1 (Marine Observation Satellite-1) and LANDSAT together with ship-borne measurements. Those behaviors can be clearly visualized through differences of water temperature and turbidity, using the data obtained by the MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), MSS (Multi Spectral Scanner), and TM (Thematic Mapper). The ship-borne measurements show that the movement of the coast water along the shoreline changes its direction mainly due to tide. Through the satellite remote sensing it can be shown how these effluents far offshore may be affected by the oceanic current and become to have geostrophic nature at fields extremely far off the exits. Author (NASDA)

N92-22904# Hiroshima Inst. of Tech. (Japan).

COASTAL ENVIRONMENTAL MONITORING BY MOS-1 MESSR DATA

Yuzo Suga *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 318-325 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)

Avail: NTIS HC/MF A22

This study deals problems encountered in acquiring the coastal environmental information from MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data. In the sea-truth experiment, the water quality parameter analysis was peformed to monitor the water pollution in Hiroshima Bay, simultaneously with MOS-1 observation. Coastal environmental information could be obtained by each single band level slice, the categorization of the maximum likelihood method, and by the principal component analysis. Author (NASDA)

N92-22905# Toyama National Coll. of Maritime Technology, Shinminato (Japan).

CASE STUDIES OF EARTH SURFACE OBSERVATION USING MOS-1. 1: COLOR OF SEA AND TRANSPARENCY. 2: SST. 3: ACTUAL VEGETATION

Shigeki Ishimori, Masashi Kawai, Takashi Machimura, Norihisa Kamibayashi, and Hiroshi Wakabayashi (Toyama Prefectural Fishery Experimental Station, Namerikawa, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 326-335 (For primary document see N92-22866 13-43)

Avail: NTIS HC/MF A22

The availability of earth surface observation using MOS-1 (Marine Observation Satellite-1) data was studied. The extent to which the MESSR (Multispectral Electronic Self-Scanning Radiometer) data explains the color of sea and transparency is addressed. In order to examine these relations, MESSR data were combined with in situ data by employing simple statistical methods. Experimental and theoretical algorithms were developed to derive SST (Sea Surface Temperature) using two thermal infrared hands of VTIR (Visible and Thermal Infrared Radiometer). The accuracy was investigated by comparing with SST's measured by ships and buoys. The feasibility of actual vegetation identification was examined with MESSR data. In this study, black and white aerial photographs were utilized as a ground reference.

Author (NASDA)

N92-22906# Japan Fisheries Information Service Center, Tokyo.

APPLICATION OF MOS-1 DATA FOR SKIPJACK FISHING GROUND FORECAST

Hideo Tameishi, Osamu Honda, Yoshihiro Okada, and Toshiyuki Kouguchi *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 336-350 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)

Avail: NTIS HC/MF A22

The application of data collected by the Visible and Thermal Infrared Radiometer (VTIR), onboard the Marine Observation Satellite-1 (MOS-1), to the fishing industry is important from a utilitarian point of view. Presently, it is useful to forecast the supply of the fishing grounds in shortage periods. However, in the past, the forecasting of fish supplies during shortages has depended upon the fisherman's intuition and experience. Using this plan, it is difficult to operate efficiently, at low cost, and according to plan. This study investigates the use of VTIR data in the forecast of fish supplies. The results may encourage the fishing industry to take advantage of VTIR data. Author (NASDA)

N92-22907# Tokyo Univ. (Japan). Ocean Research Inst.

ON THE MEASUREMENT OF THE UNDERWATER AMBIENT NOISE BY MOS-1 DCS

Jiro Segawa, Hiromi Fujimoto (Tokyo Univ. of Fisheries, Japan), and Toshiharu Kakihara *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 351-405 (For primary document see N92-22866 13-43)

Avail: NTIS HC/MF A22

In order to verify the performance of the Marine Observation Satellite-1 (MOS-1) Data Collection System (DCS), a buoy system with hydrophones that measure the underwater acoustic ambient noise was developed. In this report, the concept of this buoy system is reported. The measurement of the ambient noise is made by a conventional method with the hydrophones grounded at the sea floor or suspended from a vessel. A system which can measure noise with the help of hydrophones attached to a signal cable and suspended from a drifting buoy on the sea surface is suggested. Author (NASDA)

N92-22908# Meteorological Satellite Center, Tokyo (Japan).

ESTIMATION OF CLOUD PARAMETERS USING MULTI-CHANNEL DATA Report No. 2

Akiyoshi Mita, Masami Tokuno, Kazuhide Yamamoto, and Kazuo Sekine *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 406-415 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)

Avail: NTIS HC/MF A22

Cloud analysis was performed by using the Marine Observation Satellite's (MOS's) Visible and Thermal Infrared Radiometer (VTIR), Multispectral Electronic Self-Scanning Radiometer (MESSR), and Microwave Scanning Radiometer (MSR) data in Jul. 1987. For VTIR data, discriminant analysis of cloud types was carried out and reasonable results were obtained. For MESSR data, the brightness levels of cloud areas were analyzed, and some features present in the cloud images were investigated for MSR data. The

high spatial resolution of MESSR shows the fine structure of clouds, while MSR seems to be effective at discerning precipitating clouds. Author (NASDA)

N92-22909# Tokai Univ., Shizuoka (Japan). Faculty of Marine Science and Technology.
STUDY OF ATMOSPHERIC CORRECTION FOR THE APPLICATION OF MOS-1/MESSR TO OCEANOGRAPHY
Yasuhiro Sugimori, Niroo Natsume, Masatoshi Akiyama, and Shin Fujita *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 416-434 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

In order to determine the properties of sub-surface ocean water, the Marine Observation Satellite-1 Multispectral Electronic Self-Scanning Radiometer (MOS-1/MESSR) spectrally analyzed the radiance of upwelling water. The tentative development of an atmospheric correction algorithm for the MOS-1/MESSR, using a model originally developed for the NIMBUS-7/Coastal Zone Color Scanner, is reported. Author (NASDA)

N92-22910# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR
Yuji Ohsaki and Masaharu Fujita (Radio Research Labs., Tokyo, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 435-446 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The feasibility of microwave remote sensing of rain by using the Marine Observation Satellite's (MOS's) Microwave Scanning Radiometer (MSR) was examined as a part of the MOS validation program conducted by the National Space Development Agency of Japan (NASDA). Good agreement was found between the MSR brightness temperature map and the rain rate distribution measured by radar. This indicates a promising future of MOS's MSR for rain delineation. Rain rate estimation algorithms that use brightness temperature or excess brightness temperature to estimate rain rates, are examined by comparison with radar rain rates. Author (NASDA)

N92-22911# University of Electro-Communications, Tokyo (Japan).
IMPROVING ON ACCURACY OF PHYSICAL PARAMETER ESTIMATED BY MOS-1 MSR: EFFECT OF THE ANTENNA PATTERN
Tsutomu Suzuki, Ikuo Arai, Makoto Kaji, and Kazuhiko Morita *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 447-451 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The accuracy of sea surface temperature data, as measured by the Marine Observation Satellite's (MOS's) Microwave Scanning Radiometer (MSR), was degraded by antenna scanning in the antenna sidelobes and the rotation of the polarization. A data correction technique that can improve the accuracy is discussed. In order to improve the accuracy, an inverse filtering process was used on the data. The result shows a marked improvement in the resolution of the temperature profile. Author (NASDA)

N92-22912# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanographic Div.
UTILIZATION OF SATELLITE IMAGES FOR MARINE RESOURCES
Denzo Inagake and Akira Tomosada *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 452-464 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Some small scale sea surface phenomena, such as streamers, warm tongues, frontal eddies, etc., are detected by satellite images. Since these phenomena are believed to be related to the concentration and distribution or movement of fish schools, it was attempted to clarify the relationship between the structures and fisheries. The sea truth data were acquired during the Marine Observation Satellite-1 (MOS-1) Verification Program on 5-8 Aug. and 3-5 Dec. 1987. Additionally, a warm tongue near the Kuroshio warm-core ring was observed onboard the Soyo Maru in Sep. 1987. The warm tongue's structure was located from the sea surface to a depth of 300 m. This suggests that the small scale phenomena identified in satellite images not only really exist, but, also have structures to a considerable depth. It is considered that these phenomena are important for the distribution of fish schools and its fluctuations or migrations. The mechanism of concentration in fish schools at the purse seine fishing grounds southeast of Hokkaido Island is observed from infrared images and oceanographic observations from a research vessel conducted in summer of 1987. The possibility of estimating the size of the sardine schools by visible images is examined. Author (NASDA)

N92-22913# Chiba Univ. (Japan). Dept. of Electronic Engineering.
MOS-1 MESSR NOISE ANALYSIS
Yoshizumi Yasuda, Hua Qi, and Yasufumi Emori *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 465-471 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

A Charge Coupled Device (CCD) line sensor is used in the visible and near-infrared sensor Multispectral Electronic Self-Scanning Radiometer (MESSR) onboard the Marine Observation Satellite-1 (MOS-1) instead of the mirror scanning mechanism used in the LANDSAT Multi Spectral Scanner (MSS) and Thematic Mapper (TM). Images that were obtained by MOS-1 MESSR, LANDSAT TM, and SPOT-1 High Resolution Visible Instrument (HRVI) are analyzed to determine the noise pattern in each scanning system. Author (NASDA)

N92-22914# Chiba Univ. (Japan). Dept. of Electronic Engineering.
MOS-1 MESSR IMAGE-DRIVED MTF
Yoshizumi Yasuda, Hua Qi, and Yasufumi Emori *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 472-481 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

The method of edge-spectra division was used to drive the Modulation Transfer Functions(MTFs) of images scanned by Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self-Scanning Radiometer (MESSR), LANDSAT Thematic Mapper (TM), and SPOT-1 High Resolution Visible Instrument (HRV) systems. A Hanning window was used before the fourier transformation to avoid inaccuracy in computing the spectrum. The results indicate that the MOS-1 MESSR and SPOT-1 HRV, which use Charge Coupled Device (CCD) line sensors, have better spatial resolution than the LANDSAT TM which uses a mirror scanning mechanism. Author (NASDA)

N92-22915# Naruto Univ. of Education (Japan).
ELIMINATION OF SENSOR NOISE IN MOS-1 MESSR IMAGE
Akira Kikuchi, Shigeru Omatsu, Tosio Kitamura, Shigeki Isawa, and Miki Oguro (Tokushima Prefectural Fisheries Experimental Station, Naruto, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 482-486 (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

When the sea quality is analyzed by using remotely sensed data, the low level multi-spectral data must be used. However, the data from the Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self-Scanning Radiometer (MESSR) contain period sensor noise and a smear phenomenon which are characteristics of the operation of a Charge Coupled Device (CCD). The sensor noise is analyzed using a Fast Fourier Transformation (FFT) technique in order to examine the frequency of the noise.

Then, it is established that the period sensor noise occurs every 34 lines in the MESSR image. Finally, the sensor noise in the MESSR image is eliminated by using a Median Filter restoration procedure which can smooth the suddenly corrupted impulse noises. Author (NASDA)

N92-22916# Ministry of Construction (Japan). Coastal Engineering Div.

ESTIMATION OF RADIOMETRIC EFFICIENCY OF VTIR, MESSR BASED ON SEA TRUTH DATA

Takaaki Uda, Yoshimi Murai, and Tsutomu Takebuchi *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 487-492 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Diffusion of turbid water around the mouth of the Oi River was observed simultaneously using ships and Marine Observation Satellite-1 (MOS-1). It is found that Band 1 of the Multispectral Electronic Self-Scanning Radiometer (MESSR) data and turbidity were not directly correlated. Some data were affected by the presence of clouds, and therefore the brightness of MESSR data was overestimated. When corresponding data from Band 1 were removed, correlation between MESSR data and turbidity was improved. Author (NASDA)

N92-22917# Japan Weather Association, Tokyo.

COMPARISON OF MOS-1 VTIR DATA AND NOAA AVHRR DATA IN REFERENCE TO THERMAL AND SPATIAL RESOLUTION

Masatsuna Koga, Sei-Ichi Saitoh, Hiroshi Kokai, Yoshizumi Yasuda, Keinosuke Goto, and Masao Shimizu (Shimizu System Inst., Hokkaidou, Japan) *In* NASDA, Proceedings of the Second Symposium on MOS-1 Verification Program Dec. 1988 p 493-497 In JAPANESE; ENGLISH summary (For primary document see N92-22866 13-43)
Avail: NTIS HC/MF A22

Marine Observation Satellite-1 (MOS-1) Visible and Thermal Infrared Radiometer (VTIR) data is compared with NOAA-9 Advanced Very High Resolution Radiometer (AVHRR) data in terms of thermal and spatial resolution. Two data sets, which were gathered on 1 Jun. and 28 Oct. 1987, were evaluated. Both MOS-1 VTIR and NOAA-9 AVHRR data were gathered on each day. Initially, the Level 2 data of the MOS-1 VTIR were used and Level 0 data were not used. There was a time lag of five hours in data reception. Hence, the sea surface temperature is used for comparison because it can be assumed that the sea surface temperature remained approximately constant for the time period. The thermal resolution of MOS-1 VTIR Channel 3 is about 0.6 C. Author (NASDA)

N92-22976# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS OF THE THIRD SYMPOSIUM ON MOS-1 VERIFICATION PROGRAM (MVP), NO. 1

Mar. 1990 609 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 27 Feb. - 1 Mar. 1989 Original contains color illustrations
(JTN-92-80305) Avail: NTIS HC/MF A99

The following topics were discussed: MOS-1 (Marine Observation Satellite-1) satellite, MOS-1 Verification Program, radiometers, MESSR (Multispectral Electronic Self-Scanning Radiometer), MSR (Microwave Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), remote sensing, remote sensors, spatial resolution, antenna radiation pattern, modulation transfer function, point spread function, radiometric characteristics, image processing, atmospheric correction, geometric correction, brightness temperature, radiance, correlated color temperature, radiances, sea surface temperature, timber identification, vegetation identification, snow cover identification, sea ice identification, landslide observation, cloud observation, land cover classification, and ocean currents observation. For individual titles, see N92-22977 through N92-23028.

N92-22977# National Space Development Agency, Saitama (Japan).

OVERALL RESULTS OF MOS-1 VERIFICATION PROGRAM (MVP)

Korehiro Maeda and Hideo Satoh *In its* Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), no. 1 Mar. 1990 p 1-42 (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The Marine Observation Satellite-1 (MOS-1), Japan's first earth observation satellite, was successfully launched by N-2 Launch Vehicle from Tanegashima Space Center, NASDA (National Space Development Agency of Japan) on February 19, 1987. MOS-1 has four mission instruments: MESSR (Multispectral Electronic Self-Scanning Radiometer); VTIR (Visible and Thermal Infrared Radiometer); and DCST (Data Collection System Transponder). MOS-1 is a multipurpose satellite which can observe ocean, land, and atmosphere in wavelengths covering visible, near-infrared, thermal infrared, and microwave. The main objectives of MOS-1 are to establish fundamental earth observation technology and to observe ocean, land, and atmosphere by three radiometers and collect ocean data by DCS (Data Collection System). In order to achieve the mission objectives, NASDA developed space and ground segments. In order to evaluate MOS-1 observation system from various points of view, NASDA planned the MOS-1 Verification Program (MVP) and conducted MVP in collaboration with domestic and foreign investigators. In this paper, the outline of MOS-1 project, the outline of activity of MVP, and overall results obtained during these two years are presented. Author (NASDA)

N92-22978# Tokai Univ., Tokyo (Japan). Research and Information Center.

OUTLINE OF RESULTS IN MESSR WORKSHOP

Haruhisa Shimoda *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 43-61 (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The aim of this MESSR (Multispectral Electronic Self-Scanning Radiometer) Workshop is to clarify some aspects of MOS-1 (Marine Observation Satellite-1) Verification Program which largely depend upon the analysis algorithms. Three kinds of areas have been selected for the Workshop. They are: (1) atmospheric correction; (2) estimation of spatial resolution of MESSR; and (3) capability of MESSR data for land use classification. In the atmospheric correction study, several kinds of algorithms estimating atmospheric parameters (i.e., transmittance and path radiance) have been tested at the same test site with the aid of various kinds of ground truth data. In the study of ground resolution estimation of MESSR data, several MTF (Modulation Transfer Function) estimating algorithms as well as several kinds of interpolating algorithms have been tested. Further, influence of relative sensor velocity to MTF has been clarified. In the study of land use classification, capability of MESSR data has been verified against the land use data verified by ground truth. Also, the capability of MESSR data has been compared with that of LANDSAT TM (Thematic Mapper). Author (NASDA)

N92-22979# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

OUTLINE OF RESULTS IN VTIR WORKSHOP

Kiyoshi Tsuchiya *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 62-71 (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The VTIR (Visible and Thermal Infrared Radiometer) Working Group has made studies focussed on the following subjects: (1) radiative transfer algorithm; (2) retrieval of sea surface temperature; (3) application of water vapor channel data; and (4) calibration accuracy. The result of the study leads to the following conclusions: (1) the radiative transfer algorithm developed by the group has a high degree of accuracy which in turn could verify the accuracy of VTIR calibration; (2) atmospheric influence on channel 4 is larger than channel 3; (3) VTIR data are useful for obtaining sea

surface temperature; (4) precipitable water may be obtained from water vapor and window channels data; (5) the following improvement are necessary, increase of quantum level from eight to ten bits and lowering the lower limit of water vapor channel to -80 C; and (6) addition of more window channels is desirable.
Author (NASDA)

N92-22980# University of Electro-Communications, Tokyo (Japan).
OUTLINE OF RESULTS IN MSR WORKSHOP
Tsutomu Suzuki *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 72-87 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Main objective of the workshop is first to evaluate the radiometric measurement accuracy of the physical parameters obtained by MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) entitled 'Observation of Atmospheric Water Vapor and Rain Rate and Observation of Land Snow and Sea Ice' by the regression method. In order to increase accuracy, it is necessary to analyze the errors included in the data of MSR and to correct them as the bias compensation. The second work, entitled 'The Evaluation of the Equivalent MSR Bias Error' is to find the equivalent bias value to be compensated. The final work, entitled 'MSR Antenna Pattern Correction by the Modified Inverse Filtering' is to correct the polarization and sidelobeerror of MSR antenna. By referring to truth data, the observation error of the water vapor at Hachijo Island became less than 2.6 kg/sq m. Bias errors are estimated to be about 21 K at 23 GHz and 18 K at 31 GHz, respectively. It is the remarkable, that the modified inverse filtering method has been proved as the most effective and practical technique for the correction of the antenna sidelobe. Author (NASDA)

N92-22981# National Aerospace Lab., Tokyo (Japan).
STUDY ON THE ESTIMATION TECHNIQUES OF SPATIAL RESOLUTION CHARACTERISTICS FOR THE MESSR
Hajime Koshiishi, Masao Naka, and Kohzo Homma *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 88-96 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

As part of MOS-1 (Marine Observation Satellite-1) Verification Program (MVP), the computational techniques for estimating spatial resolution characteristics of satellite-based optical image sensor systems have been studied. Two methods of estimating overall spatial resolution characteristics of image sensor system have been investigated; frequency domain method (Fourier transformation) and spatial domain method (spatial convolution). Several factors affecting estimation accuracy of the spatial characteristics are also investigated. An outline is presented of MOS-1 data analysis experiments for estimating spatial resolution characteristics of the MESSR (Multispectral Electronic Self-Scanning Radiometer) that include: subpixel data generation processing from multiple contiguous scan line data with slightly different phase of the step targets; and compensation processing for the degradation of sensor's spatial characteristics due to relative motion between platform (satellite) and ground scene. Some results are shown through the estimation experiments using some step targets in the Tokyo Bay of the MESSR CCT (Computer Compatible Tape) data for the PSF (Point Spread Function) and MTF (Modulation Transfer Function) characteristics of the MOS-1 MESSR.
Author (NASDA)

N92-22982# Meteorological Research Inst., Tsukuba (Japan). Meteorological Satellite and Observation System Research Div.
INVESTIGATION OF ATMOSPHERIC EFFECT TO MESSR, VTIR, AND MSR, AND OBSERVATIONS OF OCEANIC PHENOMENA USING MSR, PART 1
Yozo Takayama, Syoichi Koinuma, Tsutom Takashima, and Kazuhiko Masuda *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 97-109 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Performance of the Visible and Thermal Infrared Radiometer (VTIR) on MOS-1 (Marine Observation Satellite-1) in measuring radiation is verified by comparing the observed brightness temperature with that of computed from aerological data. The result shows VTIR is measuring radiation reasonably well. Estimated Sea Surface Temperatures (SST's) retrieved from VTIR by using different multichannel algorithms were compared. The method using the relation of the radiation emitted from sea surface and observed by VTIR gives better result, because of close approximation. A small contribution of water vapor absorption band to the obtain SST was found. Estimated SST has a RMS (root mean square) temperature difference of 0.7 C. From comparison of Band 2 data with water vapor distribution, a good correlation between water vapor density distribution at 300 mb pressure level, and the brightness temperature pattern was found. Author (NASDA)

N92-22983# Meteorological Research Inst., Tsukuba (Japan). Oceanographical Research Div.
INVESTIGATION OF ATMOSPHERIC EFFECT ON MESSR, VTIR, AND MSR AND OBSERVATIONS OF THE OCEANIC PHENOMENA USING MSR, PART 2
Akira Shibata, Yoshio Shinohara, Koji Ueno, and Kenzo Shuto *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 110-115 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

A Microwave Scanning Radiometer (MSR) which is loaded on the Marine Observation Satellite-1 (MOS-1) is shown to have the capability of observing accumulated water vapor over the ocean with observational RMS (root mean square) errors of about 2.6 kg/sq m. This observation using the MSR becomes worse in the case when it is raining at a rate of more than about 10 mm/hour, due to the scattering by large rain drops. The MSR is also shown to have the capability of observing the sea ice in the Sea of Okhotsk through clouds. Author (NASDA)

N92-22984# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
EVALUATIONS OF THE MSR ANTENNA PATTERN AND RETRIEVAL ERROR OF WATER VAPOR CONTENT
Takeyuki Ojima, Korehiro Maeda, and Hideo Satoh (National Space Development Agency, Saitama, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 116-126 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Twenty scenes of Microwave Scanning Radiometer (MSR) data obtained during May 1987 through Feb. 1988 were processed into images of water vapor and cloud liquid contents, using a retrieval algorithm. The images were used to estimate the validity of the retrieved water vapor content and of the influence of land radiation on antenna temperature. Some bias error was found in the retrieved water vapor content by comparing with radiosondes. If all the bias errors involved in the retrieval algorithms are treated as equivalent measurement errors of the MSR antenna temperature, the equivalent bias errors in the antenna temperature were found to be 21.7 and 18.7 K at 23 and 31 GHz, respectively. After correcting all data for these bias errors, the error of the retrieved water vapor content was less than 8 percent in a root mean square sense. Possible error causes of the equivalent bias errors are discussed. The effect of land radiation through antenna sidelobes on the antenna temperatures taken over the ocean near the Japanese archipelago more than 200 km offshore was found

to be correctable using a function of the offshore distance. Therefore, the data taken within 600 km offshore, which have been considered erroneous because of influence of land radiation, can be used as close as 200 km offshore. Author (NASDA)

N92-22985# Tokai Univ., Tokyo (Japan). Research and Information Center.
ESTIMATION OF MTF OF MOS-1 MESSR IMAGES
Toshibumi Sakata, Haruhisa Shimoda, and Kiyonari Fukue *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 127-146 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Saitama, Japan (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

An MTF (Modulation Transfer Function) of an MESSR (Multispectral Electronic Self-Scanning Radiometer) image was estimated using an edge spectrum ratio method. This method is based on the Fourier spectrum amplitude ratio between the real and an ideal edge through a Hanning window. This method was applied to vertical and horizontal edges in several MESSR images, 77 and 72 m were obtained as the values of the Effective Instantaneous Field of View (EIFOV) from the estimated MTF for tracking and scanning directions, respectively. Furthermore, the estimated line spread function from the obtained MTF's showed that the half value widths are 74 and 69 m for that two directions, respectively. Author (NASDA)

N92-22986# Remote Sensing Technology Center, Tokyo (Japan).
VERIFICATION OF RADIOMETRIC CHARACTERISTICS OF MESSR DATA AND VTIR THERMAL INFRARED DATA
Yukio Mukai, Shoji Takeuchi, Kazuo Watanabe, Yasunori Nakayama, Hiroshi Kimura, and Mitsunori Yoshimura *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 147-167 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Four kinds of ground targets of different reflectances of bare soil, grass field, asphalt, and water were selected to investigate the radiometric characteristics of MESSR (Multispectral Electronic Self-Scanning Radiometer). Irradiance and the spectral reflectances of the ground targets were measured at the same time of MOS-1 (Marine Observation Satellite-1) overpass, and the theoretical radiance of the ground targets observed by MESSR were estimated from the ground truth data. On the other hand, the actual radiances of the ground targets observed by MESSR were computed by examining the gray values of the ground targets in MESSR image and transforming them into radiances. Both the theoretical and actual radiances were compared and they were nearly equal in all bands. To investigate water surface temperature observation characteristics, VTIR (Visible and Thermal Infrared Radiometer) data were compared with NOAA and TM (Thematic Mapper) data obtained on the same days. Water surface temperatures derived from VTIR corresponded pretty well with those derived from NOAA but not with those from TM. This is considered because there may be some problems in estimating surface temperatures from TM. To investigate land cover classification characteristics of MESSR, a test site was selected and a land cover classification images of the test site were produced using MESSR, LANDSAT MSS (Multi Spectral Scanner) and TM data, and SPOT HRV (High Resolution Visible) data. The land cover classification characteristics of MESSR was investigated by comparing with the classified results by LANDSAT MSS, TM, and SPOT HRV.
Author (NASDA)

N92-22987# Tsukuba Univ., Ibaraki (Japan). Science Information Processing Center.
GEOMETRIC CORRECTION FOR IMAGE DATA FROM MESSR, VTIR, AND MSR SENSOR
Takashi Hoshi and Yoshifumi Sameshima *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 168-171 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The purpose of this research is to rectify the geometric distortions included in the original image data in order to perform the analysis using image data of MOS-1 (Marine Observation Satellite-1). Each corrected image is corresponded to the suitable map projection. The image data used in this research are extracted from MESSR (Multispectral Electronic Self-Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), and MSR (Microwave Scanning Radiometer) loaded on the platform of MOS-1. The data are not rectified yet. The evaluation of the results obtained from this research is carried out from the Ground Control Point (GCP) and distance points of view. Author (NASDA)

N92-22988# Geographical Survey Inst., Tokyo (Japan).
GEOMETRICAL ACCURACY OF MESSR IMAGE
Minoru Akiyama, Tamio Sekiguchi, Kesami Koido, and Hideki Sasajima *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 172-176 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

In order to estimate the geometrical accuracy of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) bulk processed data, which is the most commonly used in ordinary remote sensing analysis, some 30 Ground Control Points (GCP's) were used for obtaining transformation formulas and residuals after transformation. By using Helmert's transformation, it was confirmed that the pixel size was adjusted exactly to 50 m, and that there remained no systematic error, where RMS (Root Mean Square) error of residuals at the GPS's was around one pixel. Therefore, it is assured that film products of bulk processed data can be registered onto UTM (Universal Transverse Mercator) projected map without any rectification. As for the higher order polynomial transformation, only small improvements could be observed. The second order polynomial seems appropriate for fine geometric correction.
Author (NASDA)

N92-22989# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.
APPLICATION OF GROUND-BASED LASER BEACON FOR EARTH IMAGE CALIBRATION
Masao Takabe, Toshikazu Itabe, and Tadashi Aruga *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 177-187 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

An earth laser beacon is observed from space as a point similar to a bright star. Thus, the spot image of a laser beacon is very useful for calibration correction of the earth's surface image pictured by cameras and optical radiometers. This is because it corresponds to an infinitively small land mark whose absolute location and brightness are known precisely. The experiments tracking the MOS-1 (Marine Observation Satellite-1) and transmitting a laser beam from a ground station to the satellite have been conducted. Currently, an argon ion laser is used as a beacon, and images taken by the MESSR (Multispectral Electronic Self-Scanning Radiometer) are analyzed. In analyzing the results, geometric errors were found in the MESSR earth images and the satellite's attitude was examined from two coordinate point of the laser spot and the scene center. Author (NASDA)

N92-22990# University of Electro-Communications, Tokyo (Japan).
IMPROVEMENT OF PHYSICAL PARAMETER ACCURACY ON MSR: CORRECTION OF THE EFFECT OF MOS-1 MSR ANTENNA SIDELOBES AND ROTATED POLARIZATION
Kazuhiko Morita, Ikuo Arai, and Tsutomu Suzuki *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 188-192 In JAPANESE;

ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The accuracy of the sea surface temperature measured by MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) has been degraded by the rotation of the polarization due to antenna scanning and by the antenna sidelobes. This paper describes data correcting methods for the rotated polarization and the antenna sidelobes. The first, a simple function to correct the polarization error due to the antenna scanning was introduced. Second, in order to improve the physical parameter accuracy, a modified inverse filtering was used to suppress the error due to antenna sidelobes in both simulation and real data obtained by MOS-1 MSR. The results show increasing in the accuracy of the temperature profile. Author (NASDA)

N92-22991# Nihon Univ., Tokyo (Japan). Coll. of Industrial Technology.
A SURVEY ON LANDSLIDES AND VEGETATION IN MOUNTAIN DISTRICTS BY USING MESSR Report No. 3
Hajime Nishikawa, Yasuo Fujii, Shigeru Fukuyama, Takakazu Maruyasu, and Sotaro Tanaka (Remote Sensing Technology Center, Tokyo, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 193-197 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

This paper describes an investigation of vegetation in a mountainous district by using a MESSR (Multispectral Electronic Self-Scanning Radiometer). The vegetation of the Karasugawa River watershed have been investigated by using MESSR data which were obtained on May 31, 1987 and October 14, 1987. The difference of false color images of these data shows various conditions of the vegetation between spring and autumn. At this time, the condition of the vegetation was analyzed and the forest type was classified by processing the data at once. As a result, the characteristics of vegetation in the basin were obtained by the image processing. Author (NASDA)

N92-22992# Tokai Univ., Tokyo (Japan). Research and Information Center.
PERFORMANCE OF MESSR DATA FOR LANDCOVER CLASSIFICATION
Tsukasa Hosomura, Ryouji Yamaguchi, Yoshiaki Matsumae, Kiyonari Fukue, Haruhisa Shimoda, and Toshibumi Sakata *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 198-213 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

In order to evaluate performance of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data for landcover classification, classification accuracies of MESSR data were compared to that of LANDSAT TM (Thematic Mapper) data. The classification accuracies were estimated quantitatively with the aid of digital land-cover/use test site data which covers the area about 2 km times 10 km. MESSR data showed lower mean classification accuracy than TM data. The reason for this low accuracy was studied with the aid of several simulations concerning the ground resolution, spectral resolution, and quantization resolution. As a result of this simulation, it is clarified that the lower classification accuracy of MESSR data is mainly based on the lower spectral resolution and decrease of quantized levels. Author (NASDA)

N92-22993# Shinshu Univ., Nagano (Japan). Faculty of Engineering.
DISTRIBUTION OF LANDSLIDE OCCURRENCE NEAR NAGANO-CITY OBTAINED FROM IMAGERY ANALYSIS OF MOS-1 DATA
Hiromu Sima *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 214-221 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Visible and near infrared bands of MOS-1 (Marine Observation Satellite-1) data are used in imagery analysis to make clear the characteristics of ground surface of the Naniai region where land slides have often occurred in the past. The investigation covered an area 3.6 km in width and 4.8 km in length, divided into six by eight meshes, each of which consisted of 12 pixels and 12 lines (about 600 m by 600 m). The numerical pattern depicted by taking the mean value of ratio Band 3/Band 2 in each mesh is discussed. Accordingly, a kind of map may be drawn which represents equi-brightness interpolated on an assumption of linear relation between the two mean values. Landslide occurrence is recognized in any region having the relatively smaller values of Band 3/Band 2. It is ascertained by determining the average plane so as to satisfy the distribution of ratio Band 3/Band 2, using the two dimensional least square method. If any difference exists between the ratio Band 3/Band 2 and the average plane, a map representing 'residual' will be drawn. From a comparison of this map with the location of landslide, it is shown that it's occurrence is almost limited on the contour lines showing the relatively smaller values of Band 3/Band 2. Development of erosion due to many small streams may cause a decrease in the stability of slope and bring about the failure of sub-soil. Author (NASDA)

N92-22994# Hosei Univ., Tokyo (Japan). Coll. of Engineering.
TEST STUDY OF LAND COVER CLASSIFICATION AND SPATIAL RESOLUTION FROM MESSR DATA
Taichi Oshima, Atsushi Rikimaru, Masazumi Konishi, and Kazuo Kinoshita *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 222-228 In JAPANESE: ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The land cover classification using multispectral data are often used for the analysis of remote sensing. This study describes the verification report in terms of the green spatial distribution and how the characteristic of contents of land cover classifications by MESSR (Multispectral Electronic Self-Scanning Radiometer) and TM (Thematic Mapper) data are related to the spatial resolution of sensors and spatial size of the land cover. Author (NASDA)

N92-22995# Tokyo Inst. of Tech., Yokahama (Japan).
ACCURACY OF SPECTRAL RADIANCE FOR URBAN LAND COVER ESTIMATED BY MOS-1/MESSR
Akira Hoyano *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 229-237 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The purpose of this research is to discuss the accuracy of spectral radiance for urban land cover estimated by MOS-1/MESSR (Marine Observation Satellite-1 Multispectral Electronic Self-Scanning Radiometer) data. At first, simulated images were made from smoothing an airborne MESSR data with 0.38 x 1 m resolution. Spectral radiance of the MOS-1 image was compared with that of the simulated image. However, no strong correlation was recognized. Furthermore, the ratio of pure pixels for each category which is a component of urban land coverage in MOS-1/MESSR image have been estimated by using the above simulated images. Author (NASDA)

N92-22996# National Research Center for Disaster Prevention, Tokyo (Japan).
VERIFICATION OF THE EFFECTIVENESS OF MOS-1 MESSR AND VTIR IN THE FIELD OF DISASTER PREVENTION
Shigetsugu Uehara, Shinobu Yazaki, Toshikazu Morohoshi, Shinkichi Kishi, and Hiroshi Ohkura *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 238-271 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Five case studies for the Multispectral Electronic Self-Scanning Radiometer (MESSR) and two for the Visible and Thermal Infrared Radiometer (VTIR) were carried out. For the MESSR, the case studies were carried out as follows: (1) Detection and classification of volcanic products due to eruption; (2) Geomorphological classification for flooding; (3) Comparison of the spectral characteristics of ground covers with the ones of airborne MESSR and ground based spectrometer; (4) Detection of vegetation recovery from the damage due to accumulated volcanic products after five years from the volcanic disaster; and (5) Detection of landslide traces due to earthquake after four years. For the VTIR, the case studies were carried out as follows: (1) Estimation of atmospheric temperature on land; and (2) Estimation of sea surface temperature in winter season. In the case of MESSR (1), the result obtained with MESSR shows slightly better than the one with TM (Thematic Mapper). In the cases of MESSR (4) and (5), the analyses were done by combined use with MSS (Multi-Spectral Scanner) and TM data. The results indicate the effectiveness of MOS-1 (Marine Observation Satellite-1) MESSR. In the case of VTIR, the estimation of atmospheric temperature using Band 1, 3 and 4 data shows fairly good results, with about 1.3 C in RMS (Root Mean Square) of the errors. Author (NASDA)

N92-22997# Chiba Univ. (Japan). Remote Sensing and Image Research Center.

INVESTIGATION ON COLOR COMPOSITES OF MESSR, VTIR, AND MSR DATA

Takuji Miwa, Youichi Asahi, and Takashi Ikeda *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 272-283 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

The purpose of this report is the establishment of a method of producing good images for visual interpretation, after examination of the character of MOS-1 (Marine Observation Satellite-1) data and problems in expressing all of the information in these data on photographic films and paper. Because there is no special problem in imaging VTIR (Visible and Thermal Infrared Radiometer) and MSR (Microwave Scanning Radiometer) data, investigation is mainly made on two-scene data of MESSR (Multispectral Electronic Self-Scanning Radiometer). Because of difference of data character, sea and land area are examined separately. For comparison, TM (Thematic Mapper) images created by averaging data of each of four pixels and MSS (Multi Spectral Scanner) images are used. The are no special problems with sea area imaging. On land area, visual interpretation of MESSR images with two kinds of transfer functions and TM images are made on various objects, and the character of each data set is precisely examined. Also, effects of band combination and color sequence are examined, and the best combination and sequence are selected. It is found that ranges of MESSR data are very narrow; data levels are located low, and these images are not so suitable to visual interpretation on land area. However, it is confirmed that these images are useful at sea area. Author (NASDA)

N92-22998# Forestry and Forest Products Research Inst., Ibaraki (Japan).

EVALUATION OF MOS DATA FOR FOREST RESOURCE INVENTORY

Haruo Sawada, Yoshio Awaya, Itsuhito Ohnuki, Kazuhiko Kogi, and Fumitoshi Takahashi (Forestry and Forest Products Research Inst., Kouchi, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 284-295 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

An outline of the results of an evaluation of MESSR (Multispectral Electronic Self-Scanning Radiometer) and VTIR (Visible and Thermal Infrared Radiometer) data for a forest survey is presented. For the evaluation of MESSR data, ground survey records (tree species, mean diameter of breast height, stand height, number of trees par hectare, stand volume, etc) are gathered and used for the correlation analysis between spectral characteristics and forest conditions. Canonical correlation analysis was very effective for obtaining the MESSR data characteristics in the forest inventory. Vegetation indices derived from MESSR data were evaluated for forest type classification. And ratio indices using visible channel(s) and infrared channel(s) were found to be effective for delineating well vegetated areas. For the evaluation of VTIR data, a composite image was made using two sequence passes; a relatively cloud-free image was obtained. But lack of an infrared channel does not make it so effective for observing forest conditions. Author (NASDA)

N92-22999# Japan Forest Technical Association, Tokyo.

STUDY FOR FOREST BIOMASS REMOTE SENSING BY MESSR DATA

Iwao Nakajima, Hiroshi Watanabe, and Yukio Wada *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 296-300 (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

Vegetation and land use classification for a forest biomass study using MESSR (Multispectral Electronic Self-Scanning Radiometer) data from a forest site in Gunma and Gifu prefectures was done. LANDSAT MSS (Multi Spectral Scanner) and TM (Thematic Mapper) data classification were used for comparison. Spectral data recognition items amounted to nine and 22 categories in Gunma and ten items in Gifu using the maximum likelihood method and MESSR data processing. MESSR data recognition results showed 85.4 percent average correctness on training area coincidence, comparing 79.5 percent of MSS data, 88.8 percent by MESSR data and, 0.3 percent by TM data in Gifu. An adequate graphic display method was also tested for forest biomass classification mapping in Gunma by using the vegetation index calculation, showing results similar to those obtained with MSS data. Author (NASDA)

N92-23000# Tokyo Univ. (Japan). Inst. of Industrial Science.

GEOMETRIC CORRECTION OF VTIR IMAGERY AND ITS APPLICATIONS

Shunji Murai, Toshiaki Hashimoto, Hiroaki Kakiuchi, and Osamu Uchida (Asia Air Survey Co. Ltd., Atsugi, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 301-309 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

Studies on geometric correction of MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) imagery and its application to analysis of geosurface temperature were carried out. Two types of methods were adopted. Both made use of Ground Control Points (GCPs), which were acquired from shore lines, large rivers, etc. on topographical maps. The image coordinates corresponding to the GCPs were obtained from Band 3 because they were clearer than any other band. The first method solved a transformation function, a three dimensional polynominal, between image coordinates and geographical coordinates using GCPs. The other method treated the positions and attitudes of the satellite as the unknown variables and determined them by the colinearity equation which is utilized in photogrammetry. The calculations was carried out using the earth center rotation coordinates system where the earth surface was approximated by Bessel's ellipsoidal model, and the results were transformed into geographical coordinates. The positions and attitudes of the satellites were supposed to be functions of line number and expressed by two dimensional polynominals. The Root Mean Square (RMS) was approximately four pixels using the former method and less than one pixel using the latter. Since both utilized GCPs acquired only from land areas, the accuracy was not guaranteed in off-shore areas. But these methods, especially the latter one, were useful to geometric correction of VTIR imagery where GCPs could be acquired. In this study, the surface temperature of the objects was expressed as a bird's eye view

using Band 3 and digital elevation models; correlation between altitude and surface temperature was analyzed. Author (NASDA)

N92-23001# Kyoto Univ., Uji (Japan). Disaster Prevention Research Inst.

A STUDY OF CLOUD AND SNOW COVER OVER KINKI DISTRICT, WEST JAPAN

Jiro Inoue *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 310-314 (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

Several pairs of cloud streets are found in the central part of Kinki district, west Japan in MOS-1 (Marine Observation Satellite-1), VTIR (Visible and Thermal Infrared Radiometer) images of January 10, 1988. Meteorological observatories reported the occurrence of snowfalls despite the fact that the major area of central Kinki was clear or partly cloudy. These cloud streets are possibly produced inland and cause the local isolated snow showers. A ground traced snow survey was made in the northern part of Kinki to estimate the amount of total snow cover, but the cloud free image of MOS-1 was not available due to the short time of snow cover duration. Author (NASDA)

N92-23002# Nagaoka Technological Univ., Niigata (Japan).

OBSERVATION OF LINED-UP CUMULUS ROWS OVER THE JAPAN SEA UNDER THE WINTER MONSOON SITUATION USING MOS-1 DATA

Tosio Koike, Katumi Musiake, and Takasi Mizuno (Niigata Prefectural Goverment, Sinkou, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 315-321 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

At a frequency below 50 GHz, water vapor has a rotational absorption line at 22.235 GHz and the absorption coefficient of cloud liquid water increases with high frequency. MSR (Microwave Scanning Radiometer) observes the earth at 23.8 GHz and 31.4 GHz. These frequencies are optimal for separately retrieving water vapor and cloud liquid water contents in the atmosphere. Data processing of two scenes of the MSR and VTIR (Visible and Thermal Infrared Radiometer) aboard MOS-1 (Marine Observation Satellite-1) has been made. One scene is for verification on February 10, 1988, and another scene on January 10, 1988 is used for the estimation of water vapor and cloud liquid water distributions over the Japan Sea in wintertime. In conclusion, the water vapor and cloud liquid water contents retrieved by MOS-1 MSR and VTIR are verified qualitatively, and characteristics of cumulus group activity over the Japan Sea in wintertime in relation to water vapor convergence is identified. Author (NASDA)

N92-23003# Hokkaido Inst. of Tech. (Japan).

EVALUATION OF THE DATA MEASURED BY MSR RELATED TO SNOWPACK PARAMETER

Masahiro Suzuki, Masami Sasaki, Kazuo Fujino, and Takeo Abe (Niigata Univ., Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 322-327 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

Analyses have been conducted to related snowpack parameters to the microwave radiometric observations made by aircraft and orbiting sensors (MOS-1 (Marine Observation Satellite-1)). A comparison between ground truth data and data obtained by MSR (Microwave Scanning Radiometer) for snowpack was made, and the following is concluded: (1) the brightness temperature obtained by MSR exhibits a remarkable sensitivity to snow depth and water equivalent of snowpack; (2) snow depth/water equivalent and the brightness temperature obtained by MSR are correlated with regression line of a negative slope; however, when the snowpack is covered with new snow layer, the slope of regression line is inverted; and (3) the seasonal variations in the brightness temperature obtained by MSR on MOS-1 are correlated with those of snowpack in the area. Author (NASDA)

N92-23004# Environmental Research and Technology Inst., Tokyo (Japan).

STUDY ON SNOW HYDROLOGY THROUGH APPLICATION OF MOS-1 SATELLITE DATA

Kenji Ishihara, Tatsuo Izawa, Masaomi Akagawa, Kiyoshi Tsuchiya, Takashi Ishiyama, Masao Matumoto, Kazuo Watanabe, and Katsutoshi Kozai (Kobe Univ. of Mercantile Marine, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 328-350 (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

Using various classification methods, MESSR (Multispectral Electronic Self-Scanning Radiometer) image data of Ishikari prefecture, Hokkaido as observed during the melting snow season are classified into snow covered and snow-free areas, and the influence of vegetation in the accuracy of snow line detection is investigated. Based upon MSR (Microwave Scanning Radiometer) data covering Hokkaido and its surrounding ice-free sea, relationship between MSR brightness temperature and snow depth in the inland area, and the effect of the sea on the brightness temperature in the inland area of Hokkaido are discussed. Author (NASDA)

N92-23005# Maritime Safety Agency, Tokyo (Japan).

SYNOPTIC OBSERVATION OF SEA ICE

Toshio Hattori, Haruhiko Ura, and Satoshi Sato *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 351-358 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

In order to keep navigation safe and to prevent marine accidents, prompt reports of sea ice, which contain maps of ice made from the observation data by ships, airplanes, satellites, etc. are published. In this experiment, whether MOS-1 (Marine Observation Satellite-1) data can be available to distinguish sea ice from open water, and discrimination of sea ice forms were examined. The concentration and forms of ice are related to surface temperature, so that with VTIR (Visible and Thermal Infrared Radiometer) infrared images, sea ice from open water can be distinguished to some extent. With VTIR visible images, it is easier to discriminate sea ice, but clouds from sea ice with visible image cannot be distinguished. In the case of MESSR (Multispectral Electronic Self-Scanning Radiometer), spatial resolution is so high that it is very easy to distinguish sea ice from open water and to discriminate forms of sea ice. Author (NASDA)

N92-23006# Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

SEA-ICE FEATURES INTERPRETED IN A COMBINATION OF MULTI SENSOR DATA

Nobuo Ono *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 359-365 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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Sea ice features in the Okhotsk Sea are studied using MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) data in combination with VTIR (Visible and Thermal Infrared Radiometer) and MESSR (Multispectral Electronic Self-Scanning Radiometer) data. Results of the case study of such data set on 31 Mar. 1988 are summarized as follows: brightness temperatures (without atmospheric correction) both MSR 31 GHz (CH 4) and 23 GHz (CH 2) of Okhotsk sea-ice range widely from 150 to 225 K, and give a reasonable distribution of sea-ice features. Polynyas (open water or thin-ice areas in sea-ice region) are clearly recognized in Terpenia Bay and in Aniva Bay. The ratio of brightness temperatures (CH 4/CH 2) indicates the difference of Marginal Ice Zone (MIZ) between off the coast of Hokkaido and in the central part of the Okhotsk Sea. Author (NASDA)

N92-23007# National Research Center for Disaster Prevention, Tokyo (Japan). Branch of Oceanographic Studies.

ESTIMATION OF WAVES AND WINDS OVER SEAS IN THE COASTAL ZONE

Atsushi Takeda, Masayuki Tokuda, Shinichi Iwasaki, Isao Watabe, Toshikazu Morohoshi, and Shinobu Yazaki *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 366-371 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)

Avail: NTIS HC/MF A99

A method with which quantitative informations of ocean waves and sea surface winds are obtained from an imagery of visible bands of MESSR (Multispectral Electronic Self-Scanning Radiometer) is discussed. Discrimination of the individual waves patterns from MESSR imagery is practically difficult because of lower resolution of 50 m, while it is narrowly possible from an imagery of TM (Thematic Mapper) or SPOT. There is, however, another approach to obtain the informations from a MESSR imagery. A population density of white caps generated by wave breaking increases with increasing wind speeds. A high density of the white caps over the sea surface will be reflected on the MESSR imagery as a bright spot which can be detected. In fact, a correlation is found between densities of high brightness and wind speeds over a sea area. It can be concluded that wind speeds are estimated from MESSR imageries with considerations on the fetch and duration. Author (NASDA)

N92-23008# Central Research Inst. of Electric Power Industry, Chiba (Japan).

ADVANCEMENT OF SEA SURVEY AND OBSERVATION TECHNIQUE IN THE SEA AROUND POWER PLANTS

Naoaki Katano, Masafumi Mizutori, Hiromaru Hiraguchi, Kinya Adachi, Michiko Oishi, Shintaro Goto, and Sanae Inamura (Mitsubishi Research Inst., Inc., Tokyo, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 372-384 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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Studies were carried out on the applicability of a MESSR (Multispectral Electronic Self-Scanning Radiometer), a VTIR (Visible and Thermal Infrared Radiometer), and a MSR (Microwave Scanning Radiometer) mounted on the MOS-1 (Marine Observation Satellite-1) satellite to oceanographic observations and their estimated accuracy, based on the results of observations conducted simultaneously at sea. Regarding the water quality, a relatively high correlation was obtained with respect to chlorophyll-a, SS (Suspended Solid), and transparency through the multiple regression analysis of MESSR Bands 1 and 2, but it was difficult to extract characteristics by each water quality item. As for observation of sea-surface temperatures by VTIR, the highest correlation was obtained in the regression analysis using three infrared bands including Band 2 which was considerably affected by water vapor. As for waves, no clear correlation with MSR data was recognized. On the other hand, in the image given by X-Band radar, which has a wavelength band different from MSR, a correlation with the sea wind was recognized, thus, suggesting that from the relation between the sea wind and waves it is possible to indirectly apply these data to wave observations.

Author (NASDA)

N92-23009# Maritime Safety Agency, Tokyo (Japan). Hydrographic Dept.

MONITORING OF OCEAN CONDITIONS BY USING MOS-1 DATA

Haruo Ishii, Hideo Nishida, Minoru Kimura, Yutaka Michida, Shouichi Tsuchide, Kazuo Tsukahara, and Satoshi Sato *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 385-390 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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There are two purposes in this study: (1) estimation of the availability of MOS-1 (Marine Observation Satellite-1) data for mapping of oceanographic conditions (ocean current, temperature, and so on); and (2) examination of capability of MOS-1 data for monitoring discolored water discharged from submarine volcanoes. Systematic cloud filtering in VTIR (Visible and Thermal Infrared Radiometer) infrared image data (Band 3) was examined with visible image data (Band 1). Because variance of brightness in sea region was small compared with that of the in cloud region of both bands, the brightness values to distinguish cloud region from sea region could be decided with a two-dimensional histogram. MESSR (Multispectral Electronic Self-Scanning Radiometer) CCT (Computer Compatible Tape) data, dated July 17, 1987 was analyzed for the purpose of distinguishing discolored water discharged from the submarine volcano, Fukutoku Oka-no-Ba, which was observed from an airplane on that day. Consequently, it was shown that a certain combination of brightness (in Band 1, 2, and 3) gave discolored water. Author (NASDA)

N92-23010# Ministry of Transportation, Kanagawa (Japan). Port and Harbour Research Inst.

APPLICATION OF THE REMOTE SENSING TECHNIQUES BY SATELLITE TO THE MONITORING SYSTEM FOR MARINE CONSTRUCTION

Kazuo Murakami, Huminori Suganuma, and Yuji Miyahara *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 391-400 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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The field investigation is carried out at the mouth of Tokyo Bay for the purpose of the development of the monitoring system for marine construction by remote sensing technique. The remote sensing observations by a MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) and an aircraft MSS (Multispectral Scanner), together with the sea truth observation, were carried out simultaneously on Feb. 1988. These remote sensing data and the sea truth data are analyzed by statistical analysis. By using these data, horizontal distributions of water temperature and turbidity are obtained.

Author (NASDA)

N92-23011# National Aerospace Lab., Tokyo (Japan).

A STUDY ON INFORMATION ANALYSIS AIDS SYSTEM FOR SEA SURFACE TEMPERATURE MAPS

Hajime Koshiishi, Masao Naka, Hiromichi Yamamoto, Kohtaro Matsumoto, Kohzo Homma, Satsuki Matsumura, Hideo Takahashi, Satoru Nakamura, Hideo Tameishi, and Yoshihiro Okada (Japan Fisheries Information Service Center, Tokyo.) et al *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 401-407 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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In this study, a feasibility study on information analysis aids system for sea surface temperature image data using knowledge based processing technology has been performed. Oceanic conditions such as fronts, ocean currents, and eddies are very useful for fisheries. For extracting these oceanic conditions, the accumulated knowledge and inherited experience are indispensable, and the simplicity of the processing and the objectivity of the result are important. The knowledge based processing system has great possibilities of dealing with these problems. In this paper, the existing expert knowledge and experience used in the process of recognizing oceanic conditions are analyzed for the systematization. Furthermore, the basic structure and the implementation of a prototype knowledge based system are described. The system has been proven to work successfully in a set of experiments using MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data. Author (NASDA)

N92-23012# Tohoku Univ., Sendai (Japan). Dept. of Geophysics.
A COMPARISON OF SEA SURFACE TEMPERATURE DETECTED BY MOS-1/VTIR AND FERRIES, ISHIKARI AND OGASAWARA, AND DISCUSSION OF THE RESULTS FROM ASPECTS OF PHYSICAL OCEANOGRAPHY
Hiroshi Kawamura, Kimio Hanawa, and Yoshiaki Toba *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 408-420 (For primary document see N92-22976 13-43)
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Sea Surface Temperatures (SST) observed by MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) Band 3 (10.5-11.5 micrometers in wavelength) is compared with in-situ data set of SST obtained by the ferry Ishikari. This ferry shuttles between Nagoya and Tomakomai via Sendai along the Pacific coast of Japan in four days. The Level-2 data of five scenes of VTIR obtained from June 1987 to April 1988 are analyzed, and the SST of VTIR are carefully sampled at the check-points on the ship's course for comparison with in-situ SST obtained by the Ishikari. The comparison shows that the mean difference is -1.27 C (the VTIR data are lower) with the standard deviation of 0.77 C. It is also shown that the thermal images of VTIR can be used to observe the oceanic structure with synoptic scale. Author (NASDA)

N92-23013# Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
BUOYANCY-DRIVEN CURRENT IN THE BUNGO CHANNEL
Hideki Akiyama, Hidetaka Takeoka, and Tetsuo Yanagi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 421-433 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

The field observations at the Bungo Channel were carried out from 22 Jun. to 13 Sept. 1988 in order to investigate the behavior of buoyancy-driven current. Temporal variations in temperature, salinity, and current followed by the buoyancy-driven current were observed at Uwajima Bay. The horizontal and vertical structures of the intrusion of buoyancy-driven current were also observed at the mouth of the Bungo Channel. The Level-2 data of the Band 3 (10.5-11.5 micrometers in wavelength) of MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) are analyzed. Sea surface temperature obtained by this image is compared with in-situ temperature data. Temperature values of this image agree well with those of in-situ data within 1 C.
Author (NASDA)

N92-23014# Toba Merchant Marine Coll. (Japan). Marine Meteorology Lab.
APPLICABILITY OF MESSR AND VTIR DATA FOR MARINE OBSERVATION Report No. 2
Hiroaki Ochiai *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 434-439 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
Avail: NTIS HC/MF A99

Using the data obtained by MOS-1 (Marine Observation Satellite-1), an evaluation of remote sensing in monitoring the marine environment was performed. The results were the following: (1) the water characteristics in Ise Bay can be estimated by color sliced imagery produced from Band 1 and Band 4 of MESSR (Multispectral Electronic Self-Scanning Radiometer); (2) the sea surface temperature distribution pattern around Kuroshio Current is recognizable in color sliced imagery of VTIR (Visible and Thermal Infrared Radiometer); (3) in comparison with MSS (Multi Spectral Scanner) or TM (Thematic Mapper) data obtained by LANDSAT-5, MESSR data is sufficient to estimate the water characteristics in coastal area; and (4) in the comparison with AVHRR (Advanced Very High Resolution Radiometer) data obtained by NOAA, VTIR is concluded as very effective in estimating the sea surface temperature distribution both in coastal area and off shore.
Author (NASDA)

N92-23015# Science Univ. of Tokyo, Chiba (Japan). Dept. of Civil Engineering.
MOS-1 DATA BEING ENROLLED IN TO THE KUROSHIO EDDY OBSERVATION SYSTEM
Tsukasa Nishimura, Sotaro Tanaka, Toshiro Sugimura, and Yuji Hatakeyama (Asia Air Survey Co. Ltd., Atsugi, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 440-447 (For primary document see N92-22976 13-43)
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In this verification experiment, MOS-1 (Marine Observation Satellite-1) data were evaluated in order to use it in our Kuroshio Eddy Observation System, a real-time system designed to monitor the coherent structure of turbulence in the sea environment of Japan. The time scale of this rapidly moving target is days or tens of days, and the space scale is kilometers or hundreds of kilometers. When the system architecture of MOS-1 was specified, this coherent structure was not yet detected. The MOS-1/VTIR (Visible and Thermal Infrared Radiometer) data was verified to have a radiometric and spatial resolution satisfactory for interpretation of the coherent structure on it. The most critical issue is its lower frequency of acquisition, when an attempt to apply the data as the main force is made. Based on this verification experiment, it is recommended that one of the operation-phase Marine Observation Satellite systems will be designed to be focused on the marine coherent structure around Japan, which is a highly energetic element of the global air sea system. Author (NASDA)

N92-23016# Science Univ. of Tokyo, Chiba (Japan). Dept. of Civil Engineering.
ADAPTABILITY OF MOS-1 DATA TO VISUALIZATION OF COASTAL HYDRAULIC PHENOMENA
Sotoaki Onishi and Itsuo Sakai (All Japan Fishing Port Construction Association, Chiba.) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 448-459 (For primary document see N92-22976 13-43)
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With the object of making clear the behaviors of river effluents at such water region that the coastal and oceanic current systems interact each other, the distributions of the effluents discharged from the Kumano River into the Pacific Ocean are visualized, by using the satellite remote sensing such as MOS-1 (Marine Observation Satellite-1) as well as LANDSAT. Then, those behaviors are simulated numerically for six cases, in each of which different combinations of values of the concerning physical parameters such as rate of flow, effluent thickness, roughness at sea bed, spatial and time scales of relating phenomena are assumed and examined their importance for making up those distributions obtained with the satellite remote sensing. The numerical simulations indicate that the area, at which the effluent behaviors are controlled by the inertia, is within 10 to 15 km off the river mouth, regardless of the time and spatial scales of the concerned phenomena, the bed roughness and the effluent thickness. The directions of the effluents shall deviate to the right hand side after reaching the Coriolis force dominating field offshore, and its deviation increases with reducing the roughness at the sea bed, the discharge rate and the thickness of the effluent.
Author (NASDA)

N92-23017# Hiroshima Inst. of Tech. (Japan). Dept. of Civil Engineering.
COASTAL ENVIRONMENTAL MONITORING USING MOS-1 MESSR DATA
Yuzo Suga *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 460-464 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)
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This study deals with the problems in order to obtain the coastal

environmental information from MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data acquired by a high gain mode. Sea truth experiment performed the water quality parameter analysis to monitor the water pollution in Hiroshima Bay, simultaneously with MOS-1 observation. Coastal environmental information could be obtained by the principal component analysis. As a result, a first principal component has a accumulated contribution of 7.7 percent, then the imagery color-coded by the level slicing was generated. A characteristic of water quality in this study area which is the typical closing bay was interpreted by the analyzed imagery. It is considered that the radiometric and spatial resolution of MOS-1 MESSR data acquired by a high gain mode is available for the assessment of water quality in this bay scale. Author (NASDA)

N92-23018# Ministry of Construction (Japan). Coastal Engineering Div.

ESTIMATION OF RADIOMETRIC EFFICIENCY OF VTIR, MESSR BASED ON SEA TRUTH DATA

Takaaki Uda, Yoshimi Murai, and Tsutomu Takebuchi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 465-470 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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Diffusion of turbid water around the mouth of the Oi River was observed simultaneously using ships and MOS-1 (Marine Observation Satellite-1). It is found that Band 1 of MESSR (Multispectral Electronic Self-Scanning Radiometer) data and turbidity did not correlate with each other directly. Some data were affected by the existence of cloud, and therefore brightness of MESSR data was overestimated. When corresponding data of Band 1 were removed, correlation between MESSR data and turbidity was improved. Author (NASDA)

N92-23019# Toyama National Coll. of Maritime Technology, Shinminato (Japan).

CASE STUDIES OF EARTH SURFACE OBSERVATION USING MOS-1. 1: COLOR OF SEA AND TRANSPARENCY. 2: SST. 3: ACTUAL VEGETATION

Shigeki Ishimori, Masashi Kawai, Takashi Machimura, Norihisa Kamibayashi, and Hiroshi Wakabayashi (Toyama Prefectural Fishery Experimental Station, Namerikawa, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 471-483 (For primary document see N92-22976 13-43)

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The availability of MOS-1 (Marine Observation Satellite-1) data on earth surface observation was studied for three cases, as follows: (1) To what extent does the MESSR (Multispectral Electronic Self-Scanning Radiometer) data explain the color of sea and transparency; In order to examine these relations, MESSR data were combined with in situ data by employing simple statistical methods; (2) Experimental and theoretical algorithms were developed to derive SST (Sea Surface Temperature) using two thermal infrared bands of VTIR (Visible and Thermal Infrared Radiometer). The accuracy was investigated by comparing with SST measured by ships and buoys; and (3) The feasibility of actual vegetation identification was examined with MESSR data. In this study, black and white aerial photos were utilized as ground reference. Author (NASDA)

N92-23020# Okayama Univ. (Japan). Faculty of Engineering.

ENVIRONMENTAL SURVEY IN COASTAL REGIONS

Chuji Mori, Koichi Ozaki, Osami Kawara, and Yuzo Suga (Hiroshima Inst. of Tech., Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 484-493 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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Records of MESSR (Multispectral Electronic Self-Scanning Radiometer) with correction Level-2 were used. The locations are Okayama and Himeji (Path 24 - Row 71 and 23-71), coastal area of the Seto Inland Sea. The characteristics of the area are as follows: Individual units of land use are fragmented and complicated. Currents in the sea change in both velocity and direction at place by place, with time by time. There are so many small islands, that enough number of ground control points can be found. Geometrical accuracy of MESSR records is fairly good. Transformations between the image coordinates of MESSR and UTM (Universal Transverse Mercator) coordinates, and also between the two image coordinates, show that the error is smaller than one pixel pitch. At sea surface, noise of CCT (Computer Compatible Tape) count is within the limit plus or minus one count, and the characteristics of it differ from scene to scene. An easy and effective method for eliminating the noise is to do median filtering. It was recognized that differences of radiance on a sea surface could be found from the data recorded by low gain. CCT count changed according to the two kinds of sea truth data, suspension solids and chlorophyll-a. Several types of relations between them were found from a regression analysis. Reliability of the relations is not so good at present. Author (NASDA)

N92-23021# Japan Fisheries Information Service Center, Tokyo.

APPLICATION OF MOS-1 MESSR DATA FOR FISHING GROUND OF COASTAL AREA

Hideo Tameishi, Osamu Honda, Yoshihiro Okada, and Toshiyuki Kouguchi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 494-501 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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This study presents outlines of basic estimation as follows: (1) It is investigated whether the relationship between optical data of MESSR (Multispectral Electronic Self-Scanning Radiometer) and fishing-ground; (2) The computed irradiance in MOS-1 (Marine Observation Satellite-1) Band 1 and 2 was normalized by the ratio of Band 1/Band 2 and the relationship between the ratio and the distribution of chlorophyll-a, and the formation of sardine fishing ground are investigated; and (3) Whether the oceanographical phenomenon such as small-scale eddies at the coastal zone is able to be expressed. To verify the effectiveness of MOS-1 MESSR are compared with simultaneous fishing ground data. The results were obtained as follows: (1) It seems that the MOS-1 VTIR (Visible and Thermal Infrared Radiometer) data are applicable to forecasting of skipjack fishing ground. Because, the mean correct discrimination rate reached 82 percent for MOS-1 VTIR data and proved its usefulness; (2) Mackerel fishing ground in coastal area are formed on the boundary between the coastal turbid waters and the offshore clear ones; (3) Sardine and anchovy fishing grounds in coastal area are formed on the frontal zone of water color in coastal turbid waters area; (4) MOS-1 MESSR imagery which represents the results of Band 1/Band 2 fit in well with the sea truth data of chlorophyll-a distribution. The fishing grounds of sardine are formed at the edge of its maximum irradiance; and (5) It seems that a small scale eddy (20 km across), exit on MOS-1 MESSR imagery. Author (NASDA)

N92-23022# Asia Air Survey Co. Ltd., Atsugi (Japan).

VERIFICATION OF RADIOMETRIC CHARACTERISTICS OF MESSR AND VTIR DATA BY COMPARISON WITH LANDSAT AND NOAA DATA

Michio Yokota, Kentaro Narigasawa, Kazuya Saitoh, Nobuyuki Mizutani, and Kazumi Yamazaki *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 502-514 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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MESSR (Multispectral Electronic Self-Scanning Radiometer) data of clear and turbid water areas in Tokyo Bay were compared with existing LANDSAT MSS (Multi Spectral Scanner) and TM (Thematic Mapper) data of the same areas. The difference in average MESSR CCT (Computer Compatible Tape) counts in clear water areas and turbid water areas was smaller than the difference observed in TM data and almost the same with the difference

observed in MSS data. VTIR (Visible and Thermal Infrared Radiometer) data were compared with NOAA AVHRR (Advanced Very High Resolution Radiometer) data. The ratio of effective radiometric resolution of VTIR to that of AVHRR was approximately 0.22. Large scale temperature distribution pattern of sea surface was detected by VTIR images as well as AVHRR images. VTIR data of two successive days also proved that the data can show a change in temperature distribution pattern. Author (NASDA)

N92-23023# Seikai Regional Fisheries Research Lab., Kokubu (Japan).

MAPPING OF ENVIRONMENTAL FACTORS OF THE SEAWATER ON THE ESTUARIES IN WESTERN KYUSHU USING MOS-1 DATA

Shiroh Uno, Kazuya Saitoh, and Sam Wouthuyzen (Nagasaki Univ., Bunkyo, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 515-521 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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The map of some environmental factors at the estuaries in western Kyushu was attempted to make using satellite 'MOS-1 (Marine Observation Satellite-1)' data. The sea truth data on chlorophyll and Seston indicated low correlation coefficients with the image density of MOS-1. Only the coefficients of transparency in the Ariake Bay exceeds 0.6 at the formula of Band 2/Band 1. Then distribution map of the transparency was made by this calculation. The tendency of the distribution was reliable, however some unreasonable higher values were found at some areas in the open sea or in the central part of the bay. These low values of the correlation coefficients would be depended on the peculiarity of the bay; higher concentration of phytoplankton and inorganic soil materials from rivers. Author (NASDA)

N92-23024# Lake Biwa Research Inst., Shiga (Japan).

MONITORING OF LAKE ENVIRONMENTS BY MOS-1

Michio Kumagai, Hiroto Maeda, and Yukio Onishi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 522-529 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)

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A verification experiment to monitor lake environments by MOS-1 (Marine Observation Satellite-1) was performed. Comparing MESSR (Multispectral Electronic Self-Scanning Radiometer) data with lake-truth data, the surface distribution of SS (Suspended Solid), chlorophyll-a and transparency can be estimated. The estimated values from MESSR data, which were taken on fine days, yielded good agreement with field data. In Lake Biwa, however, a better estimation of water quality distribution requires the data in both northern and southern basin, because there is a wide water quality difference between the two basins.

Author (NASDA)

N92-23025# Tohoku Regional Fisheries Research Lab., Miyagi (Japan).

MONITORING OF UNDERWATER FOREST PRODUCTION BY USING MOS-1

Mitsuyuki Hirai, Kazuya Taniguchi, and Norihito Tsuzuki (Nakanihon Air Service Co. Ltd., Aichi, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 530-537 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)

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It is important to estimate the production of seaweeds for appropriate management of fishing grounds for herbivores, such as abalones and sea urchins. Diving survey and image processing of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) and air-borne MSS (Multi Spectral Scanner) were carried in the Arame (Eisenia Bisylis) population on the coast of Oshika Peninsula, to examine the feasibility of MOS-1 MESSR as a estimation method for its production. The characteristic distribution pattern of Arame investigated by diving was retrieved by MSS image, however, such pattern could not be recognized on MOS-1 MESSR images. Consequently, it is concluded that MOS-1 MESSR data is less feasible to estimate the production of seaweeds in the coastal waters. Author (NASDA)

N92-23026# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanographic Div.

UTILIZATION OF SATELLITE IMAGES FOR MARINE RESOURCES

Denzo Inagake and Akira Tomosada *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 538-548 In JAPANESE; ENGLISH summary Prepared in cooperation with National Space Development Agency, Tokyo, Japan (For primary document see N92-22976 13-43)

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A lot of small-scale phenomena at the sea surface are detected by satellite images. Since these phenomena are estimated to have important roles not only for the oceanographic structures but also for the concentration, distribution or movement of fish schools, it has been tried to make clear those structures and their roles for fisheries resources. The sea truth data were acquired synchronized to the MOS-1 (Marine Observation Satellite-1) Verification Program on August 5-8, and December 3-5, 1987. And small scale phenomena such as a warm tongue and a cold streamer around the Kuroshio warm-core ring were observed on board the R/V (Research Vessel) Soyo Maru. These observation results suggest that small scale phenomena around the Kuroshio warm-core ring recognized in some satellite images not only really exist but also have structures to the considerable depth. It is considered that these phenomena are important for the distribution of fish schools and their migrations. We are trying to make clear the mechanism of the concentration of mackerel schools at spawning grounds around Izu Islands in winter 1987 and of sardine schools at nursery grounds southeast of Hokkaido Island in summer 1987, using some infrared images. The possibility is being examined that the sardine schools can be detected directly by visible images.

Author (NASDA)

N92-23027# Remote Sensing Technology Center, Tokyo (Japan).

CAPABILITY OF DETECTION OF KUROSHIO AXIS FROM MSR DATA

Sotaro Tanaka, Toshiro Sugimura, Kazuo Watanabe, Tsukasa Nishimura, and Yuji Hatakeyama (Asia Air Survey Co. Ltd., Atsugi, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 549-556 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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Using MOS-1/MSR (Marine Observation Satellite-1 Microwave Scanning Radiometer) data, a capability of Kuroshio axis detection was tested. The result is that MOS-1/MSR bands, i.e., 23 GHz and 31 GHz, are not effective in detecting the sea surface temperature, because the radiation increment from the sea surface in these bands which depends upon its temperature is less than that which depends upon the other physical parameters. However, a less meaningful result that the water vapor increases in proportion to the sea surface temperature, and the brightness temperature increases in proportion to the water vapor evaporated from the sea surface, was obtained. Consequently, the MSR responses virtually to the sea surface temperature in clear sky condition. But, the pure MSR response to the sea surface temperature is relatively very weak against the noise caused by the water vapor in the transmitting path. Increment of MSR measure by Kuroshio axis thermal increment corresponds to about 1 mm water vapor. This noise makes the measurement of Kuroshio axis difficult in actual weather condition. New band test between 1 GHz to 8 GHz in which the band radiation depends more upon the sea

surface temperature is requested. Improvement of the spatial resolution and pure data detection with less side lobe are also necessary. Author (NASDA)

N92-23028# Nagasaki Univ. (Japan). Dept. of Civil Engineering.

DETECTION OF WATER RESOURCES AND THEIR RESERVATION ON THE SEA BASED ON SATELLITE REMOTE SENSING

Keinosuke Gotoh and Masatoshi Mori (Kinki Univ., Osaka, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 1 Mar. 1990 p 557-571 In JAPANESE; ENGLISH summary (For primary document see N92-22976 13-43)

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A concept was proposed to reserve the ground water which flows out to the seashore and snow water discharges into the sea. The utility of large sea as water resources reservation base seems to have some prospects. If the realization of this concept is possible, then the contribution to the solution of water shortage can be expected not only in Japan but all over the world. For selecting the proposed building sites of marine reservation base, it is necessary to know the place where the ground water flows out or the place of snow water discharged into the ocean. In this study, pilot projects which analyze seashore ground water which flows out of Shimabara Peninsula and snow water which flows into the Ishikari Bay from Ishikari River, were carried out using satellite remote sensing techniques. The satellite data used in the former study were LANDSAT/TM (Thematic Mapper) data, the latter uses VTIR (Visible and Thermal Infrared Radiometer) and MESSR (Multispectral Electronic Self-Scanning Radiometer) data from MOS-1 (Marine Observation Satellite-1). Next, the reservation method together with the advantaged points and effectiveness of seashore ground water and snow water reservation is mentioned. The utilization of marine-reserved water resources was developed for life and industrial use, Ocean Thermal Energy Conversion (OTEC) use, mitigation of food shortage and so on. Finally, a method for detecting seashore ground water was designed using MOS-1/MESSR combined with a small submarine and an underwater television camera. Author (NASDA)

N92-23029# National Space Development Agency, Saitama (Japan). Earth Observation Center.

PROCEEDINGS OF THE THIRD SYMPOSIUM ON MOS-1 VERIFICATION PROGRAM (MVP), NO. 2

Mar. 1990 466 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 27 Feb. - 1 Mar. 1989 Original contains color illustrations

(JTN-92-80306) Avail: NTIS HC/MF A20

Papers concerning the Marine Observation Satellite-1 (MOS-1) are presented. The following topics are addressed: the MOS-1 Verification Program, radiometers, MESSR (Multispectral Electronic Self-Scanning Radiometer), MSR (Microwave Scanning Radiometer), VTIR (Visible and Thermal Infrared Radiometer), remote sensing, remote sensors, spatial resolution, antenna radiation pattern, modulation transfer function, point spread function, radiometric characteristics, image processing, atmospheric correction, geometric correction, brightness temperature, radiance, computer compatible tape, radiances, sea surface temperature, timber identification, vegetation identification, snow cover identification, sea ice identification, landslide observation, cloud observation, land cover classification, and ocean currents observation. For individual titles, see N92-23030 through N92-23063.

N92-23030# Kanazawa Inst. of Tech. (Japan). Lab. of Information Science.

THE ESTIMATION OF ATMOSPHERIC SCATTERING AND TOPOGRAPHIC EFFECTS ON THE MOS-1 IMAGERY

Yoshiyuki Kawata, Takashi Kusaka, Atsuhisa Ohtani, and Hitoshi Kubo *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 1-13 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

The atmospheric scattering effect on the image data measured by the MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) is estimated. The basic algorithm which converts the measured satellite-level radiance data into the ground albedo data in a flat terrain case is presented. In this conversion the values of relevant atmospheric parameters such as the optical thickness, the single scattering albedo, and the turbidity factor of the atmosphere were adopted from a model atmosphere given by LOWTRAN 6 code in the evaluation of scattering and transmission functions. Lambert's law was assumed as a bidirectional reflection at the ground surface. Then, the classification for such ground albedo data was performed. It was found that the atmospheric correction has little effect on the overall classification accuracy for a single data set. But, when the classified maps are looked at carefully, favorable changes in category in the map based on the ground albedo data set can be detected. Then simple radiometric correction methods which remove both the atmospheric and topographic effects from the MOS-1 MESSR data over a rugged terrain are proposed. They were applied to a mountainous test site with known digital terrain data. Both of the Lambert's and Minnaert's laws were examined as a bidirectional reflection at the mountain slopes. It has been found that the Minnaert's law gives better results than the Lambert's law. Author (NASDA)

N92-23031# National Research Inst. for Pollution and Resources, Tokyo (Japan).

THE INFLUENCE OF ATMOSPHERE AND SOLAR RADIANCE ON MESSR

Osayuki Yokoyama, Masayasu Hayashi, Koji Kitabayashi, Susumu Yamamoto, Kisaburo Nakata, and Shoichi Taguchi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 14-19 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

The MESSR (Multispectral Electronic Self-Scanning Radiometer) onboard MOS-1 (Marine Observation Satellite-1) is discussed. Satellite detected radiances were compared among bands obtained at the same area of Kashimanada on 2-3 Dec. 1987. The ratios of radiance among four bands changed during these days, which suggests a difference of optical properties of aerosols. Next, the satellite detected radiances were also compared with radiances simulated by LOWTRAN 6. This study reveals that the detected radiance was more than 50 percent larger than that calculated for Band 1. The discrepancies between the observation and the simulations for Band 2 and 3 were less than 50 percent. The detected radiances for Band 4 were more than twice as large as that of the simulation. The discrepancy in Band 1 is caused by ignorance of multiple scatter. It was found that the horizontal distribution of aerosols is detectable as long as relative humidity and surface reflectance are given. Author (NASDA)

N92-23032# National Inst. for Environmental Studies, Tsukuba (Japan).

A STUDY ON EVALUATION OF ATMOSPHERIC EFFECT ON MULTISPECTRAL ELECTRONIC SELF-SCANNING RADIOMETER (MESSR) DATA BY SPECTRAL MEASUREMENT U@04SASANO, YASUHIRO@05HAYASHIDA, SACHIKO

Y. Yasuoka, T. Miyazaki, Y. Iikura, Y. Sasano, and S. Hayashida *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 20-28 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

Atmospheric parameters were estimated by three different methods to evaluate the atmospheric effect on the MESSR (Multispectral Electronic Self-Scanning Radiometer) data. The atmospheric transmittance and the path radiance were estimated from a set of radiance data which were the upward radiance

measured above water surface and the radiance detected by the MESSR at the corresponding points. Also the transmittance was estimated from the measurement of direct solar radiation. Further the transmittance was estimated from the laser radar data.
Author (NASDA)

N92-23033# Institute of Physical and Chemical Research, Saitama (Japan). Earth Science Lab.
RETRIEVAL OF WATER QUALITY PARAMETERS FROM RADIANCE DETECTED BY MESSR
Shigehiko Sugihara and Motoaki Kishino *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 29-35 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

It is difficult to estimate water quality parameters such as chlorophyll concentration in surface water from the radiance collected by the MESSR (Multispectral Electronic Self-Scanning Radiometer) of the MOS-1 (Marine Observation Satellite-1) because of the low CCT (Computer Compatible Tape) counts over the water and also inclusion of the path radiance which acts as noise in estimating the water quality parameters. For water rich in phytoplankton, however, the radiance emerging from below the water surface is large and estimation of chlorophyll concentration might be possible. In order to test the possibility for estimating the chlorophyll concentrations in Lake Kasumigaura from the MOS-1 MESSR data, atmospheric transmittance and the sky radiance were observed to estimate the path radiance on November 7, 1988. In addition, chlorophyll concentrations were determined directly in the sampled surface waters. After the removal of the path radiance, chlorophyll concentration was estimated. Since the correlation between observed and estimated concentrations is good, chlorophyll concentration can possibly be determined from the MESSR data collected over the rather turbid waters.
Author (NASDA)

N92-23034# National Research Inst. for Pollution and Resources, Tokyo (Japan).
EVALUATION OF SPECTRAL RADIANCE OF INLAND SEA WATER IN MOS-1 MESSR IMAGES
Masamitsu Onitsuka, Kazuyuki Ohta, and Tsuyoshi Samukawa *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 36-44 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

An extraction method for water color by use of a MOS-1 (Marine Observation Satellite-1) data set was studied. This method contained two major parts, the reduction of path radiance from the original data and decomposition from the upward intensities just above the sea surface to x10, y10, and z10 components. From the MOS-1 data set, the water color for the center part of Tokyo Bay was estimated with the set of values x10 = 0.29, y10 = 0.33, and z10 = 0.38, which shows that the MOS-1 data set contained considerable amounts of light reflected from the sea surface. The numbers of the water color index were estimated by use of Band 1 and Band 2 data, as follows: N(sub C) = -25.01 + 86.88(0.360)L0(Band 1) + 0.679(L0)(Band 2)/L0(Band 1) + L0(Band 2); N(sub D) = -24.25 + 85.70(0.360)L0(Band 1) + 0.679(L0)(Band 2)/L0(Band 1) + L0(Band 2), where N(sub C) and N(sub D) were the numbers of water color with respect to the C light source and D65 light source, respectively. L(sub 0)(Band 1) and L(sub 0)(Band 2) represented the intensities of Band 1 and Band 2 after path radiance correction. Author (NASDA)

N92-23035# Hirosaki Univ. (Japan). Dept. of Earth Sciences.
ACCURACY OF THE ESTIMATES OF SEA SURFACE TEMPERATURE BY THE MOS-1 INFRARED RADIOMETER
Kunio Rikiishi and Hideo Yamashita *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 45-51 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

Estimates of the sea surface temperature by the MOS-1 (Marine Observation Satellite-1) infrared radiometer are compared with the in situ observations of research vessels. An empirical relation between the brightness temperature and in situ observation is obtained as T = (1.20(T3) - 2.87) + 0.76(T3 - T4), where T3 and T4 are brightness temperatures through the windows of Channel 3 and 4, respectively, and T is the in situ observation. The temperature determined by the empirical relation has a probable error of +/- 1.12 C. This may be explained by the following: the resolution of temperature by the MOS-1 radiometer is 0.5 C; the brightness temperature is a measurement of the skin layer to a depth of a few micrometers while the in situ observation is that of the surface layer to a depth of about 1 m; and the observational time and place of satellite imagery do not exactly coincide with those of ship surveys. Author (NASDA)

N92-23036# Far Seas Fisheries Research Lab., Shimizu (Japan). Oceanography and Southern Ocean Resources Div.
VERIFICATION FOR WATER MASS ANALYSIS RELATED TO FISH ECOLOGY AND FISHING GROUND FORMATION
Satsuki Matsumura *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 52-85 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) images were discussed in terms of their use for water mass analysis by a fisheries scientist. Coastal water distribution patterns could be clearly seen using Band 4 and Band 5. Compared to the LANDSAT MSS (Multi Spectral Scanner), the range of the radiative resolution of the MESSR is slightly higher than that of the MSS. However, any difference in radiance could not be seen in off-shore waters. After the air correction, no significant change was seen because the difference of aerosol density is deemed to be small in comparison with the radiative resolution. Verification for the DCS (Data Collection System) of MOS-1 was also done in the Bering Sea. Although the Bering Sea area is almost at the useful performance limit for the DCP (Data Collection Platform), the EOS (Earth Observation Satellite) could catch the signal and calculate the position. The DCP buoy was onboard the R/V (Research Vessel) . This led to a positioning accuracy of 3 - 5 km. In practical terms, this is a significant value. Author (NASDA)

N92-23037# Tokai Regional Fisheries Research Lab., Tokyo (Japan). Oceanic Fisheries Dept.
MEASUREMENT OF THE UNDER WATER TEMPERATURE USING MOS-1 DCP
Akira Kuroiwa *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 86-107 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

In successful fishing operations, it is useful for fishermen to have access to information about variations in ocean conditions, such as water temperatures and currents. The onboard oceanic data collection system for fisheries (DCP-7 (Data Collection Platform-7)), which collects data concerning underwater temperatures from the vessel and relays the data to the land station through MOS-1 (Marine Observation Satellite-1) DCS (Data Collection System), is discussed. The underwater temperature data measured by XBT (Expendable BathyThermograph), were formalized codes of eight frames and transmitted automatically to MOS-1 from DCP-7. The investigation of this system was implemented to evaluate the difference between the data directly measured onboard and the data recorded by the system, DCP-7.
Author (NASDA)

N92-23038# National Research Inst. of Fisheries Engineering, Tokyo (Japan). Engineering Fisheries Agency.
STUDY ON DRIFTING-DATA COLLECTION BUOY USING MOS-1
Eiichi Imanari, Akio Ikeda, Kouichi Sawada, and Yoshimi Takao

In NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 108-132 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

Until just recently, it was said that new fishing ground and untouched resources for the benefit of fisheries have to be dug up. But nowadays, it can be said that the growth of fisheries is to control the fishing ground and resources. Therefore it is necessary to investigate more exactly, more extensive marine information to control them. In Japan the first marine observation satellite, named MOS-1 (Marine Observation Satellite-1), was launched with expectation at February 19, 1987. So Drifting-type Data Collection Buoy (DDCB) with a link in the chain of MOS planning were designed. This report describes an outline of this buoy and result of experiment for verification using MOS-1. Author (NASDA)

N92-23039# Maritime Safety Agency, Tokyo (Japan). Hydrographic Dept.
STUDY ON DATA COLLECTION SYSTEM
Yosizo Ueno and Taiji Imoto *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 133-142 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

The capacity of the data collection system on the performance of the satellite MOS-1 (Marine Observation Satellite-1) was examined. Error of positioning, available distance for data transmission and limited distance for positioning, were examined by sending wave data observed with drifting buoy which had been manufactured. Consequently, the smallest error of positioning was 5 m, the largest one was 1,120 m and positioning errors were within 600 m. Limited distance for data sending was measured by sending data from buoy to the moving vessel. The longest distance for receiving data was about 4,020 km. It was shown that the position was calculated within about 3,000 km. Author (NASDA)

N92-23040# Tokyo Univ. (Japan). Ocean Research Inst.
ON THE MEASUREMENT OF THE UNDERWATER AMBIENT NOISE BY MOS-1 DCS
Jiro Segawa, Hiromi Fujimoto, and Toshiharu Kakihara (Tokyo Univ. of Fisheries, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 143-177 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

Two sets of drifting buoys with hydrophones for MOS-1 (Marine Observation Satellite-1) DSC (Data Collection System) verification program were developed. The tests of these drifting buoys were made at five coastal or offshore areas of Noto Peninsula, Kamaishi, Kochi, Amakusa, and Oki Islands in summer 1988. The tracking and recovery of the buoy and collection of underwater ambient noises was successful. It was found from the observations, that the spectra of the ambient noise have in general the negative slope against the frequency at each area and that the levels of the noise reveal the locality affected by the sound environments surrounding the observation site. In the coastal sea areas, the observation area of Kochi, for instance, the ship traffic noise and man-made noise was prominent. On the other hand, the wind dependent noise was found at offshore site where the noise level is lower because of less contamination by the ship traffic noise. The noise caused by the noise measuring instrument itself is also mentioned. Author (NASDA)

N92-23041# Meteorological Satellite Center, Tokyo (Japan).
ESTIMATION OF CLOUD PARAMETERS USING MULTI-CHANNEL DATA
Akiyoshi Mita, Masami Tokuno, Kazuhide Yamamoto, and Kazuo Sekine *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 178-193 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

Cloud analysis was performed by using MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer), MSR (Microwave Scanning Radiometer) and MESSR (Multispectral Electronic Self-Scanning Radiometer) data. For VTIR data, discriminant analysis of cloud types was carried out using the data for summer and winter, respectively, and reasonable results were obtained. As for MSR data, comparisons with weather radar data were made to see the capability to discern precipitating clouds over the ocean. Using MESSR data, fine horizontal structure of clouds was investigated, and an attempt was made to estimate the cloud top height of cumuliform clouds. However, the applicability of MSR and MESSR data to meteorological analysis is limited due to their narrow scene coverage. Author (NASDA)

N92-23042# Chiba Univ. (Japan). Remote Sensing and Image Research Center.
COMPARISON OF DIFFERENT SENSOR DATA AND CHARACTERISTICS OF CIRRUS CLOUD
Kiyoshi Tsuchiya, Masami Tokuno, Takashi Ishiyama, Masao Matsumoto, and Ryutaro Tateishi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2 Mar. 1990 p 194-206 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

Taking advantage of MOS-1 (Marine Observation Satellite-1) capability of simultaneous observation of a same target with different sensors, following studies are made: (1) effects of a sub-pixel cloud; (2) radiative characteristics of cirrus and cumulus clouds; and (3) applicability of water vapor band data of VTIR (Visible and Thermal Infrared Radiometer). It was found that an extremely thin cirrus above the sea can be effectively identified in the high gain mode data of MESSR (Multispectral Electronic Self-Scanning Radiometer) Band 1 and Band 2 while fairly difficult in Band 3 and Band 4 data. Influence of a small cumulus on IR (Infrared) channel extends beyond the size of cumulus perhaps due to a resampling procedure. The effect of a very thin cirrus on the visible channel of VTIR is small, however it gives an effect on TBB (Black Body Temperature) of Channel 3 as large as -1.5 C which is significant for sea surface temperature estimation. The data of water vapor channel of VTIR is useful to obtain water vapor distribution and location of a jet stream axis.
Author (NASDA)

N92-23043# Meteorological Research Inst., Tsukuba (Japan).
AN INVESTIGATION OF THE BIAS ERROR IN THE OBSERVED BRIGHTNESS TEMPERATURE OF VTIR
Tadao Aoki, Kiyotaka Shibata, Yoshinari Mizuno, Masashi Fukabori, and Teruo Aoki *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 202-206 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

VTIR (Visible and Thermal Infrared Radiometer) observed brightness temperatures have been compared with the theoretical calculations in the high latitudinal region of winter season. The purpose of this comparison is to check whether a bias error is contained in the observed brightness temperature. It has been found that at least in the limited number of comparisons there is no systematic discrepancy between the theoretical values and the observations. Author (NASDA)

N92-23044# Chiba Univ. (Japan). Remote Sensing and Image Research Center.
ANALYSIS OF SHADOWING EFFECTS OF THE EARTH'S SURFACE USING MESSR DATA
Hiroshi Okayama *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 207-216 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

When the shadowing effects are applied to MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data, the path radiance and the skylight

components are removed. As the training areas the Yufutsu open plain area near Tomakomai and the plain area around the Saroma Lake of Abashiri in Hokkaido were selected. The variation of the band ratio of data corrected using the shadowing effects are larger than those obtained when the shadowing effects are not considered. Therefore it is thought that in the analysis of the remote sensing information if the shadowing effects are used, the classification and discrimination of the object are made effectively. Author (NASDA)

N92-23045# Tokai Univ., Shizuoka (Japan). School of Marine Science and Technology.

OCEAN COLOR INFORMATION RETRIEVAL ON MESSR DATA

Yasuhiro Sugimori, Hajime Fukushima, and Shin Fujita *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 217-225 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

In attempting to extract ocean color data from MESSR (Multispectral Electronic Self-Scanning Radiometer), two aspects, correction or removal of atmospheric effect and estimation of phytoplankton pigment concentration, are discussed. The study first investigates applicability of the Gordon Clark atmospheric correction scheme which has been widely accepted and used for NIMBUS-7/CZCS (Coastal Zone Color Scanner) data processing. Also discussed is expected error in pigment estimation due to the quantization. The performance is compared with that of LANDSAT Thematic Mapper data. It is pointed out that future sensors should be equipped with an observation band in shorter wave length region to attain enough sensitivity for phytoplankton pigments in open ocean. Author (NASDA)

N92-23046# Japan Marine Science and Technology Center, Tokyo. Marine Research and Development Dept.

EVALUATION OF ATMOSPHERIC EFFECT ON IMAGE OF VTIR

Kei Muneyama, Ichio Asanuma, and Yasunori Sasaki *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 226-263 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

Equations of the atmospheric correction for a practical observation of sea surface temperatures by MOS-1/VTIR (Marine Observation Satellite-1 Visible and Thermal Infrared Radiometer) were obtained for the day and night observation from data observed simultaneously by VTIR and a research vessel. Sea surface temperatures obtained with the atmospheric correction showed that the data of VTIR are useful for the practical oceanography, and compared with that is obtained by AVHRR (Advanced Very High Resolution Radiometer) on NOAA-10. Image qualities of VTIR and AVHRR were compared, where both data were obtained with two hours difference, on the warm core ring off Sanriku. A difference of sensors showed a different response on line profiles along a warm core ring and current. It is expected for VTIR to have higher resolutions in temperature and higher response in sensor for the middle scale oceanography as in warm core rings or in the Kuroshio warm current. Author (NASDA)

N92-23047# Ministry of Posts and Telecommunications, Kashima (Japan). Kashima Space Research Center.

MEASUREMENTS OF RAIN RATE DISTRIBUTION BY MOS-1 MSR

Yuji Ohsaki and Masaharu Fujita (Radio Research Labs., Tokyo, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 264-277 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

An algorithm for estimation of rain rate from MOS-1 (Marine Observation Satellite-1) MSR (Microwave Scanning Radiometer) data, previously developed on the basis of the radiative transfer theory, is examined in comparison with the rain rate data observed by the weather radar of the Japan Meteorological Agency on the top of Mt. Fuji. The MSR brightness temperature has been related to the radar-derived rain rates. There exists considerable scatter in the comparison between the rain rates derived from the MSR brightness temperature and from the radar measurements. This may partly be attributable to the non-uniform distribution of rain in the MSR FOV (Field of View). Problems in accurate estimation of rain rate with future satellite-borne microwave radiometers are also pointed out. Author (NASDA)

N92-23048# Chiba Univ. (Japan). Dept. of Electronic Engineering.

MOS-1 MESSR IMAGE QUALITY ANALYSIS. PART 3: TIME SERIES CHANGE

Yoshizumi Yasuda, Hua Qi, and Yasufumi Emori *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 278-291 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

This paper describes about the assessment of MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) data in terms of the time series change of MTF (Modulation Transfer Function), noise, and average CCT (Computer Compatible Tape) level, utilizing the three MOS-1 imageries of Tokyo Bay. The method of edge spectra ratio was used to drive MTF. Noise was analyzed using a FFT (Fast Fourier Transformation) technique on a flat sea area. And average CCT levels were computed on the largest common area over the three scenes. As a result, no change occurred in MESSR's spatial resolution performance. The same noise pattern appeared in all three scenes. Radiometric correction process cannot correct the noise formed by the different sensitivity or off-set in even and odd number elements in the CCD (Charge Coupled Device) line sensor; conversely it produces new noise in some cases. Geometric correction processes produce the horizontal fringe noise. Average CCT level relatively decreased about 20-25 percent in Channel 1, 2, and 3 during the first year after the launch and did not change in the second year. Author (NASDA)

N92-23049# Naruto Univ. of Education (Japan).

PROBLEMS OF SEA MEASUREMENT BY MOS-1 MESSR AND THEIR BETTERMENT

Akira Kikuchi, Omatu Sigeru, Tosio Kitamura, Shigeki Isawa, and Miki Oguro (Tokushima Prefectural Fisheries Experimental Station, Naruto, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 292-303 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

In Seto Inland Sea, red tide is a serious problem and causes a great deal of damage to young yellow fish that breed every summer. The red tide is a phenomenon of the rapid growth of phytoplanktons. The phenomenon of the sea color as seen in MESSR (Multispectral Electronic Self-Scanning Radiometer) images is easily recognized. However, there are three problems for the analysis of red tide when using MOS-1 (Marine Observation Satellite-1) MESSR images: (1) matching image data and sea truth data when cloudy; (2) extraction of spectral characteristics of phytoplanktons by using four spectral images of MESSR with six bits; and (3) elimination of horizontal stripe noise in low level sea area of MESSR, which is caused by the cubic convolution procedure. In this report, the improvement of these problems is considered. A restoration algorithm of the periodical noisy image in the third problem is constructed. Author (NASDA)

N92-23050# Japan Weather Association, Tokyo. Meteorological and Environmental Investigation and Management Center.

COMPARISON OF MOS-1 VTIR DATA AND NOAA AVHRR DATA IN REFERENCE TO THERMAL AND SPATIAL RESOLUTION

Masatsuna Koga, Seiichi Saitoh, Hiroshi Kokai, Yoshizumi Yasuda,

Keinosuke Goto, and Masao Shimizu (Shimizu System Inst., Hokkaidou, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 304-315 In JAPANESE; ENGLISH summary (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

MOS-1 (Marine Observation Satellite-1) VTIR (Visible and Thermal Infrared Radiometer) data is compared with NOAA-9 AVHRR (Advanced Very High Resolution Radiometer) data with special reference to thermal and spatial resolution. In this study, two data sets gathered on June 1, and Octover 28, 1987 are employed. Both MOS-1 VTIR and NOAA-9 AVHRR data were gathered on the same day. There is a time lag of 5 hours between each data set. Therefore, sea surface temperature is used for the comparison between two data sets. As a result, the thermal resolution of MOS-1 VTIR Channel 3 is estimated about 0.6 C.
Author (NASDA)

N92-23051# European Space Agency. ESRIN, Frascati (Italy). Earthnet Programme Office.
UTILISATION OF MOS-1 DATA IN EUROPE
L. Fusco and G. M. Pinna *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 316-334 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

This paper reviews the activities related to the MOS-1 (Marine Observation Satellite-1) data exploitation in Europe. At first, the European users' needs and the potential applications in Europe of MOS-1 data are summarized. Then, the European MOS-1 data system is described. Details of MOS-1 data acquisition, archiving, cataloging, processing, user services and products availability are given. Finally, the status and near future plans on the European MOS-1 Data Utilization Program (EMDUP) are presented.
Author (NASDA)

N92-23052# Centre National d'Etudes Spatiales, Toulouse (France).
MESSR IMAGE QUALITY
P. Henry and G. Begni *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 335-347 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

During the whole SPOT program, CNES (Centre National d'Etudes Spatiales) has used methods to check the SPOT image quality. The same methods have been applied to MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) images in order to assess their image quality performances, both from the radiometric and geometric points of view. The following performances have been studied: (1) image dynamics; (2) radiometric resolution, including detector noise, residual equalization noise, and global signal to noise ratio; (3) control of structural noise; (4) Modulation Transfer Function (MTF); (5) band to band registration; (6) locating accuracy; and (7) length distortion.
Author (NASDA)

N92-23053# Centre National d'Etudes Spatiales, Toulouse (France).
MOS-1 ABSOLUTE CALIBRATION USING SPOT1 AS AN INTERMEDIATE RADIOMETER
P. Henry and G. Begni *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 348-359 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

The on-board absolute calibration systems for earth observation satellites should be backed up by ground-based measurements. P. N. Slater has developed and routinely uses an absolute calibration procedure over the White Sands Desert, New Mexico, U.S.A. This procedure, however, cannot be directly used for MOS-1 (Marine Observation Satellite-1) since the calibration area is not in the visible range of any observation center. A secondary site (without any ground measurements) was used for a simultaneous MOS-1 and SPOT-1 observation. Using SPOT-1 as an intermediate radiometer, the White Sands measurements were transferred to the secondary test site. This allowed a MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) to achieve absolute calibration. An error budget was made in order to determine the method accuracy.
Author (NASDA)

N92-23054*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
RESULTS OF MOS-1 MSR, VTIR, AND MESSR DATA QUALITY EVALUATIONS AT NASA
Roy W. Spencer, Gary J. Jedlovec, and Robert J. Atkinson *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 360-370 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20 CSCL 05B

An evaluation of the Microwave Scanning Radiometer (MSR), the Visible and Thermal Infrared Radiometer (VTIR) and the Multispectral Electronic Self-Scanning Radiometer (MESSR) on the Japanese Marine Observation Satellite-1 (MOS-1) has been performed. Data from all three instruments have been analyzed using image processing systems at NASA's Marshall Space Flight Center (MSFC). Analysis of the MOS-1 orbital parameters and the MSR, VTIR, and MESSR scan geometries allow the use of software developed for the Man-computer Interactive Data Access System (McIDAS) at MSFC to navigate and re-map these data into different projections and to display them with other data bases at the same time. Most of the evaluation concentrated on data quality but potential applications of the sensor data were investigated. The data were of good quality and met many of the pre-launch requirements and specifications. Several relatively minor problems were noticed in the data from all three of the instruments. These problems were not severe and in most cases did not significantly restrict application of the data.
Author (NASDA)

N92-23055# National Oceanic and Atmospheric Administration, Washington, DC. National Environmental Satellite, Data and Information Service.
USE OF MARINE OBSERVATION SATELLITE-1 IN APPLIED OCEAN SCIENCE
Robert A. Warner and William G. Pichel *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 371-372 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

The objective of this study is to examine data from the three sensors onboard the MOS-1 (Marine Observation Satellite-1) satellite from an oceanographic data user's viewpoint for ocean science applications. This study is to take the fundamental first steps in evaluating MOS-1 sensors for applied ocean color, temperature, and to estimate the location of ice edges. This preliminary work in comparing the MOS-1 sensors to other satellite sensors and to available reference data is presented, and an overview on the hardware and software personal computer system used in this study is presented.
Author (NASDA)

N92-23056# Canada Centre for Remote Sensing, Ottawa (Ontario).
PRELIMINARY EVALUATION OF TYPICAL CANADIAN SCENES OF MOS-1 IMAGERY
M. Manore and T. Butlin *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 376-386 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

The Marine Observation Satellite-1 (MOS-1) imaged selected parts of Canada during the spring, summer, and fall of 1988. The areas imaged were the sites of onging remote sensing experiments and, thus, a great deal of ancillary information is available to assist in the evaluation of the MOS-1 imagery. All the imagery was cataloged and is accessible in quicklook form on analog video disk or on VHS video tape to the Canadian MOS-1 Project Team.

In addition, uncorrected computer compatible tapes were made of the several typical, well understood scenes to assist in determining the processing steps that will be required before the data can be used by team members to evaluate the use of the MOS-1 imagery for agriculture, forestry, geology, oceanography, and sea ice. The evaluation of this uncorrected imagery is discussed.

Author (NASDA)

N92-23057# National Research Council, Bangkok (Thailand). Remote Sensing Center.

MVP ACTIVITIES IN THAILAND

Suvit Vibulsresth, Darasri Srisaengthong, and Chanchai Peanvijarnpong *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 387-392 (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

This paper describes Thailand's activities in MOS-1 (Marine Observation Satellite-1) Verification Program (MVP). The National Research Council of Thailand (NRCT) and Thai government agencies from remote sensing data user community have conducted verification of MOS-1 data for various disciplines. Other activity to support of the MVP is the reception of MOS-1 data not only for Thai Principal Investigators (PI's) and but also for other PI's in Southeast Asia. Author (NASDA)

N92-23058# Korean Inst. of Energy and Resources, Seoul (Republic of Korea).

EVALUATION OF MOS-1 DATA FOR GEOLOGIC APPLICATION: LINEAMENT INTERPRETATION

Pil-Chong Kang and Kwang-Hoon Chi *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 393-404 (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

The study was focused on the applicability of the MOS-1 (Marine Observation Satellite-1) data for lineament interpretation and mineral deposits such as gold, silver, copper, lead, zinc, tungsten, and clay minerals connecting with the lineaments which were interpreted on the MOS-1 images. The lineaments interpreted on the MOS-1 image are 2156 in number, and major trends of those are N65 deg E, N15 deg E, N85 deg W, and N25 deg W. In general, the mineral deposits in the study area are related with lineaments, that is, the Cu, Zn, and Pb deposits are distributed more in the area where the 25 deg and 155 deg trend lineaments are concentrated and pyrophyllites are mainly emplaced along the N20 deg - 30 deg E trend lineaments. The result is different from the previous study (1976, Kim), that is, the lineaments interpreted on MOS-1 are more in number than those of LANDSAT MSS (Multi-Spectral Scanner) (1976), and also the predominant trends are different from the previous study (1976). Such differences might be due to spatial resolution and the image scale difference which is used in both cases. The MOS-1 data can be enlarged more than LANDSAT MSS data for practical application.

Author (NASDA)

N92-23059# Korea National Maritime Police, Inchon (Republic of Korea).

STUDY ON SURFACE OCEAN TEMPERATURE AND OCEAN COLOR DISTRIBUTION IN THE MID-WEST COASTAL WATERS OF KOREA

Chang-Sup Lee, Jung-Kee Choi, Kwang-Hoon Chi, and Pil-Jong Kang (Korean Inst. of Energy and Resources, Seoul, Republic of Korea) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 405-411 (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

An attempt was made to derive sea water turbidity of the Yellow Sea by analyzing Marine Observation Satellite-1 (MOS-1) Multispectral Electronic Self-Scanning Radiometer (MESSR) band 2 imagery and sea surface temperature by analyzing MOS-1 Visible and Thermal IR Radiometer (VTIR) band 3 imagery. The sea water turbidity data derived from satellite imagery was compared and checked with the ground truth data collected from the test sites. Ground truth data for the sea surface temperature were not available so the digital count of the satellite data was density sliced and displayed in color to present the relative temperature difference. Author (NASDA)

N92-23060# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Land Use Planning Div.

STUDY ON SUGARCANE AND RICE FOR YIELD ESTIMATION

Manu Omakupt, Damrong Buapradabkul, Anusorn Chantanaroj, and Suthep Chutiratanaphant *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 412-421 (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

The objectives of MOS-1 (Marine Observation Satellite-1) Verification Program for Land Development Department in Thailand is to investigate sugar cane and rice area in Suphan Buri Province to estimate yield. The MESSR (Multispectral Electronic Self-Scanning Radiometer) CCT (Computer Compatible Tape) data, photoproduct was analyzed by a Dipix computer system. Combined with the ground truth data, the preliminary sugar cane and rice area map was produced. Furthermore, crop production estimation was conducted by visual interpretation of the aerial photographs and MESSR photoprint of the selected test site.

Author (NASDA)

N92-23061# Royal Forest Dept., Bangkok (Thailand). Remote Sensing and Data Collection in Forestry Center.

APPLICATION OF MOS-1 DATA FOR CLASSIFICATION OF FOREST RESOURCE

Boonchana Klankamsorn and Thongchai Charuppat *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 422-436 (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

The Royal Forest Department received MOS-1 (Marine Observation Satellite-1) data from NASDA (National Space Development Agency of Japan) in November 1988. The visual interpretation and image analysis were conducted in December 1988. MOS-1 data were verified for forestry applications in January 1989. The results of this study revealed that MOS-1 MESSR (Multispectral Electronic Self-Scanning Radiometer) data can be used for classification of existing forest and non-existing forest areas in Thailand. Moreover, mangrove forest areas can be classified from other forest types. In some areas, if evergreen and dry dipterocarp forest types occur in widely spread areas, they can be classified by using the help of bioclimatic and physiographic factors. Author (NASDA)

N92-23062# Ministry of Agriculture and Cooperatives, Bangkok (Thailand). Dept. of Agriculture.

THE APPLICATION OF MOS-1 DATA TO MONITOR THE ENCROACHMENT OF SUGAR CANE PLANTATION INTO RICE FIELDS OF WEST CENTRAL PLAIN AREA

P. Piyapongse, E. Hansakdi, T. Akiyama, and Y. Yamagata (National Inst. of Agro-Environmental Science, Ibaraki, Japan) *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 437-441 (For primary document see N92-23029 13-43)

Avail: NTIS HC/MF A20

Sugar cane is an important economic crop of Thailand. The area allotment of each planting season has always created very serious problems between the sugar cane planters and sugar manufactures in the study areas, due to the production capacity of each of the refineries. In a productive year, the price of sugar cane drops remarkably, causing serious problems for the planters. The use of MOS-1 (Marine Observation Satellite-1) data proved to be a promising method to detect the encroachment of sugar cane plantation into rice fields. The results of 1987-88 data indicated the encroachment of about three to five percent in the study area compared to area planted in 1985. A spectroradiometer would yield very satisfactory results in supporting the MSS (Multi

Spectral Scanner) and MESSR (Multispectral Electronic Self-Scanning Radiometer) satellite's data. Author (NASDA)

N92-23063# National Univ. of Singapore.
VERIFICATION ACCURACY OF GEOPHYSICAL VALUES
Yean Joo Chong *In* NASDA, Proceedings of the Third Symposium on MOS-1 Verification Program (MVP), No. 2, Mar. 1990 p 442-449 (For primary document see N92-23029 13-43)
Avail: NTIS HC/MF A20

MOS-1 (Marine Observation Satellite-1) MESSR (Multispectral Electronic Self-Scanning Radiometer) scene ID 10594-03152 (path 38 row 118 W, October 5, 1988) was been investigated. The scene covers the southern end of the Straits of Malacca, as well as areas in Indonesia, Malaysia, and Singapore. The CCT (Computer Compatible Tape) were processed on a computer. Unsupervised classifications were carried out. Data for sub-scenes were down loaded on to an PC-AT compatible microcomputer and the images were displayed on the microcomputer color monitor using enhanced graphics. The images show urban, industrial, agricultural, and forested areas. These images may be of use to those concerned with the environmental problems of reservoirs and their water catchment areas; of a protected area for migratory birds; and of land newly reclaimed from the sea.
Author (NASDA)

N92-23100# Academy of Sciences (USSR), Moscow. Space Research Inst.
STATISTICAL PHOTOCLINOMETRIC METHODS FOR THE ANALYSIS OF SURFACE TOPOGRAPHY
K. Muinonen, K. Lumme, B. Zhukov, J. I. Peltoniemi, M. Kaasalainen, and W. M. Irvine 1990 17 p
(Rept-1631) Avail: NTIS HC/MF A03

Two new statistical photoclinometric methods are introduced for the recovery of information on the small scale topography of an atmosphereless body. The methods are applicable if the area under consideration does not exhibit dominating features such as hills or large craters, but shows clearly defined shadowed portions (shadow method) or variations in the surface brightness (brightness method). The shadow method will be shown to be independent on any albedo variations on the illuminated fraction of the surface. On the other hand, when the scattering law is well known and the amount of shadows on the surface is negligible, the brightness method can be used to recover the surface statistics. Both methods have been preliminarily verified through numerical simulations of Gaussian surfaces. Author

N92-22799# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA. Atmospheric Directorate.
A VIRTUAL SENSOR FOR EVAPORATION DUCTS: THE IMPACT OF DATA UNCERTAINTIES
John Cook *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p Sponsored by Space and Naval Warfare Systems Command (For primary document see N92-22790 13-46)
Copyright Avail: NTIS HC/MF A15; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-22832# European Space Agency, Paris (France).
BACKGROUND MATERIAL: INTRODUCTION
P. Goldsmith *In its* Report of the Earth Observation User Consultation Meeting Oct. 1991 p 61-68 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22842# Arbeitsgemeinschaft der Grossforschungseinrichtung, Bonn (Germany, F.R.).
RESOURCE MANAGEMENT: INTRODUCTION
J. Bodechtel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 133-135 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22843# Joint Research Centre of the European Communities, Ispra (Italy). Inst. for Remote Sensing Applications.
RENEWABLE RESOURCES: AGRICULTURE. INTRODUCTION
J. Meyer-Roux and T. LeToan (Centre d'Etude Spatiale des Rayonnements, Toulouse, France) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 136-147 Original contains color illustrations (For primary document see N92-22826 13-42)
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N92-22844# Zurich Univ. (Switzerland).
WATER RESOURCES, SNOW AND ICE: INTRODUCTION
H. Haefner and H. Rott (Innsbruck Univ., Austria) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 148-160 (For primary document see N92-22826 13-42)
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N92-22845# Joint Research Centre of the European Communities, Ispra (Italy). Inst. for Remote Sensing Applications.
FORESTRY: ENVIRONMENTAL ASPECTS
J.-P. Malingreau and P. Reichert (Food and Agriculture Organization of the United Nations, Rome, Italy) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 161-172 (For primary document see N92-22826 13-42)
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N92-22846# Arbeitsgemeinschaft der Grossforschungseinrichtung, Bonn (Germany, F.R.).
NON-RENEWABLE RESOURCES
J. Bodechtel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 173-180 (For primary document see N92-22826 13-42)
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N92-22847# Ludwig-Maximilians-Univ., Munich (Germany, F.R.). Inst. fuer Meteorologie.
LAND TRANSFORMATION, LAND USE AND CARTOGRAPHY: LAND-SURFACE TRANSFORMATION PROCESSES
H. J. Bolle *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 181-192 (For primary document see N92-22826 13-42)
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N92-22848# University Coll., London (England).
CARTOGRAPHY: CURRENT REQUIREMENTS FOR TOPOGRAPHIC MAPPING
I. Dowman *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 193-195 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22849# Maryland Univ., College Park.
LAND USE PLANNING: INTRODUCTION
J. Townshend *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 196-206 (For primary document see N92-22826 13-42)
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N92-22851# Technische Univ., Delft (Netherlands).
SOLID EARTH FROM SPACE: GRAVITY FIELD, MARINE GEOID AND PRECISE POSITIONING. INTRODUCTION
R. Rummel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 214-219 (For primary document see N92-22826 13-42)
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44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-22109# Massachusetts Municipal Wholesale Electric Co., Ludlow.
ELECTRIC THERMAL STORAGE DEMONSTRATION PROGRAM
1992 94 p
(Contract DE-FG01-89CE-28310)
(DE92-007262; DOE/CE-28310/T1) Avail: NTIS HC/MF A05

In early 1989, MMWEC, a joint action agency comprised of 30 municipal light departments in Massachusetts and on affiliate in Rhode Island, responded to a DOE request to proposal for the Least Cost Utility Planning Program. The MMWEC submission was for the development of a program, focused on small rural electric utilities, to promote the use of electric thermal storage heating systems in residential applications. This report discusses the demonstration of ETS equipment at four member light departments. DOE

N92-22110# Massachusetts Municipal Wholesale Electric Co., Ludlow.
ELECTRIC THERMAL STORAGE DEMONSTRATION PROGRAM
1992 54 p
(Contract DE-FG01-89CE-28310)
(DE92-006629; DOE/CE-28310/T2) Avail: NTIS HC/MF A04

In early 1989, MMWEC, a joint action agency comprised of 30 municipal light departments in Massachusetts and one affiliate in Rhode Island, responded to a Department of Energy request to proposal for the Least Cost Utility Planning program. The MMWEC submission was for the development of a program, focused on small rural electric utilities, to promote the use of electric thermal storage heating systems in residential applications. In this progress report, cost savings at Bolyston Light Department is discussed. DOE

N92-22173# Passive Solar Industries Council, Washington, DC.
PASSIVE SOLAR DESIGN STRATEGIES: REMODELING GUIDELINES FOR CONSERVING ENERGY AT HOME
1991 132 p
(Contract DE-FG01-90CE-21005)
(DE92-006576; DOE/CE-21005/T1) Avail: NTIS HC/MF A07

The idea of passive solar is simple, but applying it effectively does require information and attention to the details of design and construction. Some passive solar techniques are modest and low-cost, and require only small changes in remodeler's typical practice. At the other end of the spectrum, some passive solar systems can almost eliminate a house's need for purchased heating (and in some cases, cooling) energy - but probably at a relatively high first cost. In between are a broad range of energy-conserving passive solar techniques. Whether or not they are cost-effective, practical, and attractive enough to offer a market advantage to any individual remodeler depends on very specific factors such as local costs, climate, and market characteristics. Passive Solar Design Strategies: Remodeling Guidelines For Conserving Energy At Home is written to help give remodelers the information they need to make these decisions. Passive Solar Design Strategies is a package in three basic parts: the guidelines contain information about passive solar techniques and how they work, and provides specific examples of systems which will save various percentages of energy; the worksheets offer a simple, fill-in-the-blank method to pre-evaluate the performance of a specific design; and the worked example demonstrates how to complete the worksheets for a typical residence. DOE

N92-22386*# Alabama Univ., Huntsville. Computer Engineering.
FURTHER STUDY OF INVERSION LAYER MIS SOLAR CELLS Final Report
Fat Duen Ho 13 Apr. 1992 23 p
(Grant NAG8-096)
(NASA-CR-190212; NAS 1.26:190212) Avail: NTIS HC/MF A03 CSCL 10A

Many inversion layer metal-insulator-semiconductor (IL/MIS) solar cells have been fabricated. As of today, the best cell fabricated by us has a 9.138 percent AMO efficiency, with FF = 0.641, V(sub OC) = 0.557 V, and I(sub SC) = 26.9 micro A. Efforts made for fabricating an IL/MOS solar cell with reasonable efficiencies are reported. The more accurate control of the thickness of the thin layer of oxide between aluminum and silicon of the MIS contacts has been achieved by using two different process methods. Comparison of these two different thin oxide processings is reported. The effects of annealing time of the sample are discussed. The range of the resistivity of the substrates used in the IL cell fabrication is experimentally estimated. Theoretical study of the MIS contacts under dark conditions is addressed. Author

N92-22654# New Energy Development Organization, Tokyo (Japan).
SURVEY ON A COLD-ENERGY SUPPLY SYSTEM USING NATURAL ENERGY
Mar. 1991 99 p In JAPANESE; ENGLISH summary
(DE92-769383; NEDO-P-9007) Avail: NTIS HC/MF A05

This paper examines how unused cold energy sources are distributed and exist in the natural world and also evaluates the feasibility of the system to take out these cold energy sources by the use of solar energy, etc. and to supply them as cold energy to the surrounding area. Using a heat supply model building located at the dam-lake side, the system is outlined in the following three cases: dam-lake water and commercial electric power source system; dam-lake water and photovoltaic power generation system; and conventional energy system. These are viewed in terms of economy and effective energy utilization. When using a cold energy source below 10 C directly for the cold energy supply, a large effect is expected in terms of cost and energy. In a combination with the photovoltaic power generation, the problem is measured against snowfall, etc. The cold energy supply system which uses dam-lake water as a heat source of the heat pump has a large significance. A marked effect can be expected from a combination of an ice making heat pump and low temperature dam-lake water, in terms of effective energy utilization and cost reduction. DOE

N92-22740*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE 1991 NASA AEROSPACE BATTERY WORKSHOP
Jeffrey C. Brewer, comp. Washington Feb. 1992 855 p
Workshop held in Huntsville, AL, 29-31 Oct. 1991
(NASA-CP-3140; M-682; NAS 1.55:3140) Avail: NTIS HC/MF A99 CSCL 10B

The proceedings from the workshop are presented. The subjects covered include nickel-cadmium, nickel-hydrogen, silver-zinc, and lithium based technologies, as well as advanced technologies including nickel-metal hydride and sodium-sulfur. For individual titles, see N92-22741 through N92-22780.

N92-22741*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA AEROSPACE FLIGHT BATTERY SYSTEMS PROGRAM: AN UPDATE
Michelle A. Manzo *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 7-18
(For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The major objective of the NASA Aerospace Flight Battery Systems Program is to provide NASA with the policy and posture to increase and ensure the safety, performance, and reliability of batteries for space power systems. The program was initiated in

1985 to address battery problems experienced by NASA and other space battery users over the previous ten years. The original program plan was approved in May 1986 and modified in 1990 to reflect changes in the agency's approach to battery related problems that are affecting flight programs. The NASA Battery Workshop is supported by the NASA Aerospace Flight Battery Systems Program. The main objective of the discussions is to aid in defining the direction which the agency should head with respect to aerospace battery issues. Presently, primary attention in the Battery Program is being devoted to issues revolving around the future availability of nickel-cadmium batteries as a result of the proposed OSHA standards with respect to allowable cadmium levels in the workplace. The decision of whether or not to pursue the development of an advanced nickel-cadmium cell design and the qualification of vendors to produce cells for flight programs hinges on the impact of the OSHA ruling. As part of a unified Battery Program, the evaluation of a nickel-hydrogen cell design options and primary cell issues are also being pursued to provide high performance NASA Standards and space qualified state-of-the-art cells. The resolution of issues is being addressed with the full participation of the aerospace battery community.

Author

N92-22742*# Gates Aerospace Batteries, Gainesville, FL.
PROFILE OF A CELL TEST DATABASE AND A CORRESPONDING RELIABILITY DATABASE c82
George R. Brearley and Glenn C. Klein *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 27-35 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 05B

The development of computerized control, and data retrieval for aerospace cell testing affords an excellent opportunity to incorporate three specific concepts to both manage the test area and to track product performance on a real-time basis. The adoption and incorporation of precepts fostered by this total quality management (TQM) initiative are critical to us for retaining control of our business while substantially reducing the separate quality control inspection activity. Test discrepancies are all 'equally bad' in cell acceptance testing because, for example, we presently do not discriminate between 1 or 25 mV for an overvoltage condition. We must take leadership in classifying such discrepancies in order to expedite their clearance and redirect our resources for prevention activities. The development and use of engineering alerts (or guardbanding) which more closely match our product capabilities and are toleranced tighter than the required customer specification are paramount to managing the test unit in order to remain both quality and cost effective.

Author

N92-22743*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
A COMPUTERIZED AIRCRAFT BATTERY SERVICING FACILITY
Richard D. Glover *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 37-51 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The latest upgrade to the Aerospace Energy Systems Laboratory (AESL) is described. The AESL is a distributed digital system consisting of a central system and battery servicing stations connected by a high-speed serial data bus. The entire system is located in two adjoining rooms; the bus length is approximately 100 ft. Each battery station contains a digital processor, data acquisition, floppy diskette data storage, and operator interfaces. The operator initiates a servicing task and thereafter the battery station monitors the progress of the task and terminates it at the appropriate time. The central system provides data archives, manages the data bus, and provides a timeshare interface for multiple users. The system also hosts software production tools for the battery stations and the central system.

Author

N92-22744*# Phillips Lab., Kirkland AFB, NM.
AIR FORCE PHILLIPS LABORATORY BATTERY PROGRAM OVERVIEW
Shaun House *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 53-101 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Battery development and testing efforts at Phillips Laboratory fall into three main categories: nickel hydrogen, sodium sulfur, and solid state batteries. Nickel hydrogen work is broken down into a Low Earth Orbit (LEO) Life Test Program, a LEO Pulse Test Program, and a Hydrogen Embrittlement Investigation. Sodium sulfur work is broken down into a Geosynchronous Earth Orbit (GEO) Battery Flight Test and a Hot Launch Evaluation. Solid state polymer battery work consists of a GEO Battery Development Program, a Pulse Power Battery Small Business Innovation Research (SBIR), and an in-house evaluation of current generation laboratory cells. An overview of the program is presented.

Author

N92-22745*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
BATTERY AND CELL TESTING AT NASA. MARSHALL SPACE FLIGHT CENTER
Tom Whitt and Lorna Jackson *In its* The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 103-124 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

An overview covering the ten cell/battery tests ongoing at MSFC are presented. The presentation is not intended to give specific test results on any test. The purpose and related program that applies to each test is acknowledged. Except for the Combined Release and Radiation Effects Satellite (CRRES), all are energy-stored and retrieval devices at low earth orbit (LEO) cycles.

Author

N92-22746*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SUMMARY OF LDEF BATTERY ANALYSES
Chris Johnson, Larry Thaller, Harlin Bittner, Frank Deligiannis, Smith Tiller, David Sullivan, and James Bene (SAFT America, Inc., Cockeysville, MD.) *In its* The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 125-132 Prepared in cooperation with AZ Technology, Huntsville, AL (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Tests and analyses of NiCd, LiSO2, and LiCf batteries flown on the Long Duration Exposure Facility (LDEF) includes results from NASA, Aerospace, and commercial labs. The LiSO2 cells illustrate six-year degradation of internal components acceptable for space applications, with up to 85 percent battery capacity remaining on discharge of some returned cells. LiCf batteries completed their mission, but lost any remaining capacity due to internal degradation. Returned NiCd batteries tested an GSFC showed slight case distortion due to pressure build up, but were functioning as designed.

Author

N92-22747*# Tracor, Inc., Rockville, MD. Battery Technology Center.
THE SWELLING MECHANISM OF CATHODES IN Li/(CFx)(SUB n) CELLS
Nehemiah Margalit and Carl C. Baxam *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 135-150 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Active material particles spatial arrangement in combination with the nature of the electrochemical reduction mechanism were found to be the major cause of excessive swelling in cathodes in Li/(CF(x))n cells. A better understanding of the chemical reaction mechanism, a possible new role for the carbon, and a model for cathode growth are discussed.

Author

N92-22748*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PRIMARY ZINC-AIR BATTERIES FOR SPACE POWER
Bobby J. Bragg, Deborah S. Bourland, Glenn Merry, and Ron Putt (Metal Air Technology Systems International, Inc., Atlanta, GA.) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 151-184 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Prismatic HR and LC cells and batteries were built and tested, and they performed well with respect to the program goals of high capacity and high rate capability at specific energies. The HR batteries suffered reduced utilizations owing to dryout at the 2 and 3 A rates for the 50 C tests owing to the requirement for forced convection. The LC batteries suffered reduced utilizations under all conditions owing to the chimney effect at 1 G, although this effect would not occur at 0 G. An empirical model was developed which accurately predicted utilizations and average voltages for single cells, although thermal effects encountered during battery testing caused significant deviations, both positive and negative, from the model. Based on the encouraging results of the test program, we believe that the zinc-air primary battery of a flat, stackable configuration can serve as a high performance and safe power source for a range of space applications. Author

N92-22749*# Societe des Accumulateurs Fixes et de Traction, Romainville (France).
RISE TIME AND RESPONSE MEASUREMENTS ON A LiSOCl2 CELL
Caroline Bastien and Eric J. Lecomte (Etudes Techniques et Constructions Aerospatiales, Charleroi, Belgium) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 185-214 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Dynamic impedance tests were performed on a 180 Ah LiSOCl2 cell in the frame of a short term work contract awarded by Aerospatiale as part of the Hermes Space Plane development work. These tests consisted of rise time and response measurements. The rise time test was performed to show the ability to deliver 4 KW, in the nominal voltage range (75-115 V), within less than 100 microseconds, and after a period at rest of 13 days. The response measurements test consisted of step response and frequency response tests. The frequency response test was performed to characterize the response of the LiSOCl2 cell to a positive or negative load step of 10 A starting from various currents. The test was performed for various depths of discharge and various temperatures. The test results were used to build a mathematical, electrical model of the LiSOCl2 cell which are also presented. The test description, test results, electrical modelization description, and conclusions are presented. Author

N92-22750*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF INTERNAL/EXTERNAL SHORT CIRCUIT PROTECTION FOR LITHIUM D CELLS
Robert C. McDonald (Yardney Technical Products, Inc., Waltham, MA.) and Bobby J. Bragg *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 215-227 (For primary document see N92-22740 13-44)
(Contract NAS9-18279)
Avail: NTIS HC/MF A99 CSCL 10B

A brief discussion of short circuit protection for lithium D cells is given in viewgraph format. The following topics are presented: (1) historical need; (2) program objectives; (3) composite thermal switch (CTS) development; (4) laboratory cells with CTS; and (5) the incorporation of CTS into lithium D cells. Author

N92-22751*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LI/BCX (THIONYL CHLORIDE) BATTERY FOR THE NASA AN/PRC-112 SURVIVAL RADIO
Steven J. Ebel, W. D. K. Clark, D. P. Eberhard (Electrochem Industries, Inc., Clarence, NY.), and Eric C. Darcy *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 229-247 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

As part of the NASA contingency planning related to aborting a launch after liftoff, an emergency radio is required for use by the crew when they return to Earth at some unplanned location. The power source for the radio must be able to satisfy the performance requirements for the radio's mission as well as be compatible with in-cabin storage in the space shuttle. The radio needs a base load power of about 1 W with capability to handle power spikes greater then 6.5 W. A slightly enlarged battery pack using the Li/BCX chemistry in C-size cells was developed that meets these power levels and extends the operational life of the radio by over a factor of four compared to its operation using a Li/SO2 cell battery pack. In addition, the cells meet the requirements for the Li/BCX cells used for extra-vehicular activities by the crew of the shuttle. One of the major qualifying tests is the ability of the cells to withstand exposure to high temperature (149 C) without leaking. Electrical performance and thermal abuse test data will be presented for the cells. Author

N92-22752*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EMU Ag-Zn BATTERY WET-LIFE EXTENSION TEST
Bobby J. Bragg and Claude M. Wooten *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 249-260 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The Extravehicular Mobility Unit (EMU) silver/zinc (Ag/Zn) battery is an 11 cell battery of approximately 30 AH. The Ag/Zn battery is comprised of two 4-cell monoblocks and one 3-cell monoblock. A discussion of a wet-life extension test performed on the battery is given in viewgraph form. Author

N92-22753*# Hoppecke Batteries, Brilon (Germany, F.R.).
HIGH-RATE Li-MnO2 CELLS FOR AEROSPACE USE
R. Becker-Kaiser, J. Ruch, H.-J. Harms, P. Schmoede, J. R. Welsh, M.-J. Vollmers, and H. Pack *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 261-277 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

A series of comparative studies were undertaken on representative cells as objectively as possible in order to appreciate the respective advantages of the different systems. After reviewing the first test results our attention was soon focussed on the following four lithium systems: (1) Li-SOCl2; (2) Li-SO2; (3) Li-(CF(sub x))(sub n); and (4) Li-MnO2. This resulted in the decision in 1982 to adopt the Li-MnO2 system for high-rate applications. D.R.D.

N92-22754*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CALORIMETRIC EVALUATION OF 250 AHR Li/SOCl2 CELLS
Stephen F. Dawson (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Eric C. Darcy *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 279-300 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Heat generation rates for full size Li/SOCl2 Centaur cells were measured in a conduction calorimeter. Heat capacity measurements were conducted on fresh and discharged cells. Author

N92-22755*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PRELIMINARY TEST RESULTS FOR Li-SOCl2 HIGH-RATE D CELLS
Bobby J. Bragg and Paul Johnson *In* NASA. Marshall Space

Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 301-321 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The performance and abuse characteristics of 55 D-size lithium-thionyl chloride (Li-SOCl2) cells are evaluated at relatively high rates. Results from the following tests are presented: shock test, vibration test, capacity performance, uninsulated short circuit, high temperature exposure, and overdischarge. Author

N92-22756*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
RESULTS OF DEEP DOD LIFE CYCLE TESTS AT HIGH RATES ON 12Ah NiCd CELLS
Paul E. Panneton and John R. Meyer *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 325-342 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

A 12 Ah Nickel-Cadmium (NiCd) Low Earth Orbit (LEO) life cycle test that induced 47 percent more deep Depth Of Discharge cycles by mixing them with shallow DOD cycles is discussed. The test showed how aggressive recharging to a C/D ratio of 1.15 nearly doubled performance over cycling below a C/D of 1.11. D.R.D.

N92-22757*# McDonnell-Douglas Electronics Co., Saint Louis, MO. Laser and Electronic Systems Div.
NASA STANDARD 50Ah NICKEL CADMIUM BATTERY CELL: CELL-LEVEL PERFORMANCE HISTORY
Mark R. Toft *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 343-378 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The concept and design for a NASA standard Nickel-Cadmium (NiCd) battery was developed from 1975 to 1977. The cell was first manufactured in 1977-1978. A performance history of this cell design is presented in viewgraph form. Author

N92-22758*# National Space Development Agency, Ibaraki (Japan).
LIFE EVALUATION OF 35Ah Ni-Cd CELL IN JAPAN
S. Kuwajima, Nolimits Kamimori, and Ken Nakatani (Sanyo Electric Co. Ltd., Sumoto, Japan) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 379-416 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The National Space Development Agency of Japan (NASDA) began developing Nickel-Cadmium (Ni-Cd) cells for space use in 1985. Sanyo Electric was responsible for the cell design, manufacturing, and initial testing. The cell life was evaluated by NASDA in the Tsukuba Space Center (TKSC). The development is presently in the qualification Test (QT) phase. Recent life-cycle data for 35 Ah Ni-Cd cells are presented. Author

N92-22759*# Reliability Analysis Center, Rome, NY.
ANALYSIS OF NICKEL-CADMIUM BATTERY RELIABILITY DATA CONTAINING ZERO FAILURES
William K. Denson and Glenn C. Klein (Gates Aerospace Batteries, Gainesville, FL.) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 417-426 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

An analysis of reliability data on Nickel-Cadmium (NiCd) batteries (for use in spacecraft) is presented. The data were collected by Gates Aerospace and represent a substantial reliability database. The data were taken from the performance of 183 satellites which were in operation from between .1 and 22 years, for a total of 278 million cell-hours of operation. Author

N92-22760*# Naval Weapons Support Center, Crane, IN. Material Science Lab.
REPORT OF INVESTIGATIONS INTO CHARGE CADMIUM REACTIVITY: NICKEL-CADMIUM CELL ESD 91-86
Harlan L. Lewis *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 427-439 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

In Aug. 1990, a presentation was given at the 25th Ann. IECEC meeting on the results of Destructive Physical Analysis (DPA) on two successive sets of Ni-Cd cells. The cells were of two different separator types, Pellon 2505 and 2536. One cell of each separator type was analyzed on two occasions; the first pair were analyzed to establish baseline data on essentially new cells; the second pair were analyzed after the cells had been on charge-discharge cycling for a year in connection with a satellite simulation study. The gas composition found in the cells, the absence of charged cadmium in the analytical data, and the appearance of dried out portions on the Cd plates in the one year cell S/N 7 which used Pellon 2505 as its separator material, were questions which arose. These concerns are answered and the observational results are clarified. Author

N92-22761*# Auburn Univ., AL. Dept. of Chemical Engineering.
A NEW COMPOSITE ELECTRODE ARCHITECTURE FOR ENERGY STORAGE DEVICES
Richard E. Ferro, Greg M. Swain, and B. J. Tatarchuk *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 457-469 (For primary document see N92-22740 13-44)
(Grant NAG3-1154)
Avail: NTIS HC/MF A99 CSCL 10B

The research objective is to determine how the electrode microstructure (architecture) affect the performance of the nickel hydroxide electrochemical system. It was found that microstructure and additional surface area makes a difference. The best architectures are the FIBREX/nickel and nickel fiber composite electrodes. The conditioning time for full utilization was greatly reduced. The accelerated increase in capacity vs. cycling appears to be a good indicator of the condition of the electrode/active material microstructure and morphology. Conformal deposition of the active material may be indicated and important. Also higher utilizations were obtained; greater than 80 pct. after less than 5 cycles and greater than 300 pct. after more than 5 cycles using nickel fiber composite electrode assuming a 1 electron transfer per equivalent. Author

N92-22762*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPOSITE OVERWRAPPED NICKEL-HYDROGEN PRESSURE VESSELS **c24**
John Reagan and Joe Lewis (TRW, Inc., Redondo Beach, CA.) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 471-484 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 11D

The presentation is made in viewgraph format, the first of which states the purpose, which is to stimulate interest in composite overwrapped pressure vessel technology as applied to nickel hydrogen battery pressure vessels. The next viewgraph presents the history of nickel hydrogen pressure vessels over the last 15 years including materials, operating conditions, and market expansion to internationals. Basic materials properties are itemized such as thermal conductivity, corrosion resistance, and strength to weight ratio. The monolithic and composite overwrapped construction approaches are compared. A detailed description is presented of the advantages of composite overwrapped pressure vessels showing weight savings, manufacturing schedule reductions, and improved fatigue life. A discussion is also presented of B-1 application, the wide range of usable materials, and a sketch of a possible optimized design. E.R.

N92-22763*# SAFT America, Inc., Cockeysville, MD. Research and Development Center.
THE LiAl/FeS2 BATTERY POWER SOURCE FOR THE FUTURE
J. Douglass Briscoe, J. Embrey, S. Oweis, and K. Press *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 485-499 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Advanced high power density rechargeable batteries are currently under development. These batteries have the potential of greatly increasing the power and energy densities available for space applications. Depending on whether the system is optimized for high power or high energy, values up to 150 Wh/kg and 2100 W/kg (including hardware) are projected. This is due to the fact that the system uses a high conductivity molten salt electrolyte. The electrolyte also serves as a separator layer with unlimited freeze thaw capabilities. Life of 1000 cycles and ten calendar years is projected. The electrochemistry consists of a lithium aluminum alloy negative electrode, iron disulfide positive electrode, and magnesium oxide powder immobilized molten salt electrolyte. Processed powders are cold compacted into circular discs which are assembled into bipolar cell hardware with peripheral ceramic salts. The culmination of the work will be a high energy battery of 40 kWh and a high power battery of 28 kWh. Author

N92-22764*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SECONDARY LITHIUM CELLS FOR SPACE APPLICATIONS
S. Surampudi, D. H. Shen, C.-K. Huang, S. R. Narayanan, A. Attia, and G. Halpert *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 501-525 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

It is concluded that secondary lithium batteries are suitable for planetary missions requiring high specific energy, long active shelf life, and limited cycle life. Titanium disulfide cathode material meet all the requirements for rechargeable lithium cell, including high intrinsic reversibility and realizable specific energy. Secondary lithium technology is still evolving, although low capacity cells have been demonstrated and greater than 700 cycle life was achieved. Work is in progress to improve the cycle life and safety of the electrolytes, alternate lithium anode, and the separators. Author

N92-22765*# Gates Aerospace Batteries, Gainesville, FL.
THE DEVELOPMENT OF NICKEL-METAL HYDRIDE TECHNOLOGY FOR USE IN AEROSPACE APPLICATIONS
Guy Rampel, Herschel Johnson, Dan Dell, Tony Wu, and Vince Puglisi *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 527-538 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The nickel metal hydride technology for battery application is relatively immature even though this technology was made widely known by Philips' scientists as long ago as 1970. Recently, because of the international environmental regulatory pressures being placed on cadmium in the workplace and in disposal practices, battery companies have initiated extensive development programs to make this technology a viable commercial operation. These hydrides do not pose a toxilogical threat as does cadmium. Also, they provide a higher energy density and specific energy when compared to the other nickel based battery technologies. For these reasons, the nickel metal hydride electrochemisty is being evaluated as the next power source for varied applications such as laptop computers, cellular telephones, electric vehicles, and satellites. A parallel development effort is under way to look at aerospace applications for nickel metal hydride cells. This effort is focused on life testing of small wound cells of the commercial type to validate design options and development of prismatic design cells for aerospace applications. Author

N92-22766*# Eagle-Picher Co., Joplin, MO. Advanced Systems Operation.
SEALED AEROSPACE METAL-HYDRIDE BATTERIES
Dwaine Coates *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 539-581 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Nickel metal hydride and silver metal hydride batteries are being developed for aerospace applications. There is a growing market for smaller, lower cost satellites which require higher energy density power sources than aerospace nickel-cadmium at a lower cost than space nickel-hydrogen. These include small LEO satellites, tactical military satellites and satellite constellation programs such as Iridium and Brilliant Pebbles. Small satellites typically do not have the spacecraft volume or the budget required for nickel-hydrogen batteries. NiCd's do not have adequate energy density as well as other problems such as overcharge capability and memory effort. Metal hydride batteries provide the ideal solution for these applications. Metal hydride batteries offer a number of advantages over other aerospace battery systems. Author

N92-22767*# Eagle-Picher Co., Joplin, MO. Electronics Div.
SODIUM SULFUR BATTERIES FOR SPACE APPLICATIONS
James A. DeGruson *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 583-605 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

In 1986, Eagle-Picher Industries was selected by the Air Force to develop sodium sulfur cells for satellite applications. Specifically, the development program was geared toward low earth orbit goals requiring high charge and/or discharge rates. A number of improvements have been made on the cell level and a transition to a complete space battery was initiated at Eagle-Picher. The results of six months of testing a 250 watt/hour sodium sulfur space battery look very promising. With over 1000 LEO cycles conducted on this first battery, the next generation battery is being designed. This next design will focus on achieving greater energy densities associated with the sodium sulfur chemistry. Author

N92-22768*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Battery Systems Group.
SODIUM-METAL CHLORIDE BATTERIES
B. V. Ratnakumar, A. I. Attia, and G. Halpert *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 607-629 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

It was concluded that rapid development in the technology of sodium metal chloride batteries has been achieved in the last decade mainly due to the: expertise available with sodium sulfur system; safety; and flexibility in design and fabrication. Long cycle lives of over 1000 and high energy densities of approx. 100 Wh/kg have been demonstrated in both Na/FeCl2 and Na/NiCl2 cells. Optimization of porous cathode and solid electrolyte geometries are essential for further enhancing the battery performance. Fundamental studies confirm the capabilities of these systems. Nickel dichloride emerges as the candidate cathode material for high power density applications such as electric vehicle and space. E.R.

N92-22769*# Technochem Co., Greensboro, NC.
PULSED POWER MOLTEN SALT BATTERY
Shyam D. Argade *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 633-663 (For primary document see N92-22740 13-44)
(Contract F33615-88-C-2911)
Avail: NTIS HC/MF A99 CSCL 10B

It was concluded that carbon cathodes with chlorine work well. Lithium alloy chlorine at 450 C, 1 atm given high power capability, high energy density, DC + pulsing yields 600 pulses, no initial peak, and can go to red heat without burn-up. Electrochemical performance at the cell and cell stack level out under demanding test regime. Engineering and full prototype development for advancing this technology is warranted. Author

N92-22770*# Johnson Controls, Inc., Milwaukee, WI.
NICKEL HYDROGEN COMMON PRESSURE VESSEL BATTERY DEVELOPMENT
Kenneth R. Jones and Jeffrey P. Zagrodnik *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 667-673 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Our present design for a common pressure vessel (CPV) battery, a nickel hydrogen battery system to combine all of the cells into a common pressure vessel, uses an open disk which allows the cell to be set into a shallow cavity; subsequent cells are stacked on each other with the total number based on the battery voltage required. This approach not only eliminates the assembly error threat, but also more readily assures equal contact pressure to the heat fin between each cell, which further assures balanced heat transfer. These heat fin dishes with their appropriate cell stacks are held together with tie bars which in turn are connected to the pressure vessel weld rings at each end of the tube. Author

N92-22771*# Naval Research Lab., Washington, DC. Space Systems Development Dept.
A NICKEL-HYDROGEN COMMON PRESSURE VESSEL SPACEFLIGHT EXPERIMENT
J. C. Garner *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 675-685 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form on a nickel-hydrogen common pressure vessel spaceflight experiment. Information given includes the schedule and diagrams of the electrical power subsystem and control features. Author

N92-22772*# Eagle-Picher Co., Joplin, MO. Electronics Div.
TECHNOLOGY UPDATE: NICKEL-HYDROGEN COMMON PRESSURE VESSEL (CPV) 2.5V TWIN STACK CELL DESIGNS
Tim Harvey and Lee Miller *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 687-715 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form on the nickel hydrogen common pressure vessel (CPV) 2.5V twin stack cell designs. Information given includes an energy analysis, a CPV design comparison, a summary of CPV characterization testing, a comparison of discharge voltage among designs, and life test performance summaries. Author

N92-22773*# Communications Satellite Corp., Clarksburg, MD.
HEAT GENERATION DURING OVERCHARGE OF Ni/H2 CELLS
Hari Vaidyanathan, W. H. Kelly, and M. W. Earl *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 717-741 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form on the heat generation during overcharge of nickel hydrogen cells. The heat dissipated during various rates of charge and overcharge was measured, using a radiative type calorimeter. Measurements made during the charging of the cell indicated that the total heat was greatest for C/10 charge, compared with C/2 or C/4. The endothermic to exothermic transition occurred at 1.43 V for C/10 charge, and increased to 1.467 V at C/2 charge. The magnitude of the endothermic heat was only 3.7 percent of the total heat generated during charging. Experimentally measured values were compared against those calculated using a thermoneutral potential of 1.51 V. Although there was general agreement between the calculated and measured values, a significant difference existed in the instantaneous heat values for the initial stages of cell discharge. Heat dissipated during self-discharge appears to depend on the charge rate preceding open circuit stand. Author

N92-22774*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NICKEL-HYDROGEN BATTERY DESIGN FOR THE TRANSPORTER ENERGY STORAGE SUBSYSTEM (TESS)
John R. Lapinski (McDonnell-Douglas Corp., Saint Louis, MO.) and Deborah S. Bourland *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 743-761 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form on nickel hydrogen battery design for the transporter energy storage subsystem (TESS). Information is given on use in the Space Station Freedom, the launch configuration, use in the Mobile Servicing Center, battery design requirements, TESS subassembley design, proof of principle testing of a 6-cell battery, possible downsizing of TESS to support the Mobile Rocket Servicer Base System (MBS) redesign, TESS output capacity, and cell testing. Author

N92-22775*# Gates Aerospace Batteries, Gainesville, FL.
NICKEL HYDROGEN CELL DESIGN: A DESIGNER'S ASPECT
Raymond Rehm *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 763-767 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given to give insight into the methodology of nickel hydrogen cell design and the decipherment of the battery cell reference guide that was distributed to many of Gates Energy Products' customers. Cell design, stacking design, charge capacity, and dynamic response are discussed in general terms. Author

N92-22776*# General Electric Co., Philadelphia, PA. Astro Space Div.
THE EARTH OBSERVING SYSTEM (EOS) NICKEL-HYDROGEN BATTERY
Charles W. Bennett *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 769-777 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form on the Earth Observing System (EOS) nickel hydrogen battery. Information is given on the life evaluation test, cell characteristics, acceptance and characterization tests, and the battery system description. Author

N92-22777*# Gates Aerospace Batteries, Gainesville, FL.
FAULT TREE ANALYSIS: NiH2 AEROSPACE CELLS FOR LEO MISSION
Glenn C. Klein and Donald E. Rash, Jr. (Reliability Analysis Center, Griffiss AFB, NY.) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 779-807 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

The Fault Tree Analysis (FTA) is one of several reliability analyses or assessments applied to battery cells to be utilized in typical Electric Power Subsystems for spacecraft in low Earth orbit missions. FTA is generally the process of reviewing and analytically examining a system or equipment in such a way as to emphasize the lower level fault occurrences which directly or indirectly contribute to the major fault or top level event. This qualitative FTA addresses the potential of occurrence for five specific top level events: hydrogen leakage through either discrete leakage paths or through pressure vessel rupture; and four distinct modes of performance degradation - high charge voltage, suppressed discharge voltage, loss of capacity, and high pressure. Author

N92-22778*# Centre National d'Etudes Spatiales, Toulouse (France).
THE 50Ah NiH2 CELL LIFE TEST RESULTS
Thierry Jamin and Olivier Puig (Societe des Accumulateurs Fixes et de Traction, Romainville, France) *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 809-833 (For primary document see N92-22740

13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form for the 50 AhNiH2 cell life test results. Information is given on pressure vessel design, electrochemical/stack design, cell electrical characteristics, and cell life test results. Author

N92-22779*# Eagle-Picher Co., Joplin, MO. Electronics Div.
USE OF SEMI-AUTOMATED TEST SYSTEMS FOR NICKEL-HYDROGEN CELLS AND BATTERIES
Steve Girard *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 835-848 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Information is given in viewgraph form on the use of semi-automated test systems for nickel hydrogen batteries. Information is given on performance test data, the standard battery level test system, and a future data network. Author

N92-22780*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CAPACITY LOSS ON STORAGE AND POSSIBLE CAPACITY RECOVERY FOR HST NICKEL-HYDROGEN CELLS
John E. Lowery *In its* The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 849-871 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 10B

Negatively precharged nickel hydrogen cells will experience a useable capacity loss during extended open circuit storage periods. Some of the lost capacity can be recovered through cycling. Capacity recovery through cycling can be enhanced by cycling at high depths of discharge (DOD). The most timely procedure for recovering the faded capacity is to charge the cell fully and allow the cell to sit open-circuit at room temperature. This procedure seems to be effective in part because of the enlarged structure of the active materials. The compounds that formed during storage at the low electrode potentials can more easily dissolve and redistribute. All of the original capacity cannot be recovered because the lattice structure of the active material is irreversibly altered during storage. The recommendation is to use positively precharged cells activated with 26 percent KOH if possible. In aerospace applications, the benefits of negative precharge are offset by the possibility of delays and storage periods. Author

N92-22964*# Sundstrand Corp., Rockford, IL.
ANALYSIS, DESIGN, AND EXPERIMENTAL RESULTS FOR LIGHTWEIGHT SPACE HEAT RECEIVER CANISTERS, PHASE 1 Interim Report, Jul. 1989 - Jul. 1991
Michael G. Schneider, Mark A. Brege, and Gary R. Heidenreich 30 Jul. 1991 222 p
(Contract NAS3-25554)
(NASA-CR-189045; NAS 1.26:189045; AER-3562) Avail: NTIS HC/MF A10 CSCL 10B

Critical technology experiments have been performed on thermal energy storage modules in support of the Brayton Advanced Heat Receiver program. The modules are wedge-shaped canisters designed to minimize the mechanical stresses that occur during the phase change of the lithium fluoride phase change material. Nickel foam inserts were used in some of the canisters to provide thermal conductivity enhancement and to distribute the void volume. Two canisters, one with a nickel foam insert, and one without, were thermally cycled in various orientations in a fluidized bed furnace. The only measurable impact of the nickel foam was seen when the back and short sides of the canister were insulated to simulate operation in the advanced receiver design. In tests with insulation, the furnace to back side delta T was larger in the canister with the nickel foam insert, probably due to the radiant absorptivity of the nickel. However, the differences in the temperature profiles of the two canisters were small, and in many cases the profiles matched fairly well. Computed Tomography (CT) was successfully used to nondestructively demarcate void locations in the canisters. Finally, canister dimensional stability, which was measured throughout the thermal cycling test program with an inspection fixture was satisfactory with a maximum change of 0.635 mm (0.025 in.). Author

N92-22971# Midwest Research Inst., Golden, CO.
SERI ADVANCED WIND TURBINE BLADES
J. Tangler, B. Smith, and D. Jager Feb. 1992 6 p Presented at the World Congress of the International Solar Energy Society, Denver, CO, 19-23 Aug. 1991
(Contract DE-AC02-83CH-10093)
(DE92-001216; NREL/TP-257-4492; CONF-910802-3) Avail: NTIS HC/MF A02

The primary goal of the Solar Energy Research Institute's (SERI) advanced wind turbine blades is to convert the kinetic energy in the wind into mechanical energy in an inexpensive and efficient manner. To accomplish this goal, advanced wind turbine blades have been developed by SERI that utilize unique airfoil technology. Performance characteristics of the advanced blades were verified through atmospheric testing on fixed-pitch, stall-regulated horizontal-axis wind turbines (HAWTs). Of the various wind turbine configurations, the stall-regulated HAWT dominates the market because of its simplicity and low cost. Results of the atmospheric tests show that the SERI advanced blades produce 10 percent to 30 percent more energy than conventional blades. DOE

N92-23117# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY Final Report
J. R. Easoz and R. H. Herlocher (Westinghouse Electric Corp., Pittsburgh, PA.) Dec. 1991 113 p
(Contract DE-AC02-83CH-10093)
(DE92-001164; NREL/TP-214-4487) Avail: NTIS HC/MF A06

This report examines the cost-effective manufacture of dendritic-web-based photovoltaic modules. It explains how process changes can increase production and reduce manufacturing costs. Long-range benefits of these improved processes are also discussed. Problems are identified that could impede increasing production and reducing costs; approaches to solve these problems are presented. These approaches involve web growth throughput, cell efficiency, process yield, silicon use, process control, automation, and module efficiency. Also discussed are the benefits of bifacial module design, unique to the dendritic web process. DOE

N92-23119# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
MEASURED AND PREDICTED ROTOR PERFORMANCE FOR THE SERI ADVANCED WIND TURBINE BLADES
J. Tangler, B. Smith, N. Kelley, and D. Jager Feb. 1992 7 p Presented at the Windpower '91: 21st American Wind Energy Association (AWEA) Conference, Palm Springs, CA, 24-27 Sep. 1991
(Contract DE-AC02-83CH-10093)
(DE92-001215; NREL/TP-257-4594; CONF-9109112-9) Avail: NTIS HC/MF A02

Measured and predicted rotor performance for the Solar Energy Research Institute (SERI) advanced wind turbine blades were compared to assess the accuracy of predictions and to identify the sources of error affecting both predictions and measurements. An awareness of these sources of error contributes to improved prediction and measurement methods that will ultimately benefit future rotor design efforts. Propeller/vane anemometers were found to underestimate the wind speed in turbulent environments such as the San Gorgonio Pass wind farm area. Using sonic or cup anemometers, good agreement was achieved between predicted and measured power output for wind speeds up to 8 m/sec. At higher wind speeds an optimistic predicted power output and the occurrence of peak power at wind speeds lower than measurements resulted from the omission of turbulence and yaw error. In addition, accurate two-dimensional (2-D) airfoil data prior to stall and a post stall airfoil data synthesization method that

reflects three-dimensional (3-D) effects were found to be essential for accurate performance prediction. DOE

N92-22370*# Sverdrup Technology, Inc., Cleveland, OH.
THEORETICAL MODELS OF KAPTON HEATING IN SOLAR ARRAY GEOMETRIES
Thomas L. Morton *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 710-715 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10A

N92-22448*# Midwest Research Inst., Golden, CO.
MANUFACTURING WITH THE SUN
Lawrence M. Murphy, Steven G. Hauser, and Richard J. Clyne *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 217-224 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 10A

N92-22707*# Midwest Research Inst., Golden, CO.
COMMERCIAL APPLICATIONS OF NEW PHOTOVOLTAIC TECHNOLOGIES
R. McConnell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 265-273 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 10A

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-22144# Radian Corp., Research Triangle Park, NC.
URBAN AIR TOXICS MONITORING PROGRAM CARBONYL RESULTS, 1990
Jul. 1991 130 p
(Contract EPA-68-D8-0014)
(PB92-110030; EPA/450/4-91/025) Avail: NTIS HC/MF A07 CSCL 13B

The results of sampling ambient air for selected carbonyl containing compounds in 12 urban centers in the contiguous United States as part of the Urban Air Toxics Monitoring Program (UATMP) are summarized. Formaldehyde, acetaldehyde, and acetone concentrations were measured using 2,4-dinitrophenylhydrazine (DNPH)-coated silica cartridges to collect the carbonyls for subsequent analysis. Sampling and analysis followed guidance provided in U.S. Environmental Protection Agency (EPA) compendium method TO-11. Formaldehyde concentrations ranged from 0.42 to 34.5 ppbv with an average concentration for all sites of 4.2 ppbv. Site average formaldehyde concentrations ranged from 1.5 ppbv for Houston, TX (H1TX) to 7.9 for Washington, DC (W2DC). Acetaldehyde concentrations ranged from 0.37 to 9.5 ppbv, averaging 1.7 ppbv over all 1990 UATMP sites. Site average acetaldehyde concentrations ranged from 0.76 ppbv at Houston, TX (H1TX) to 2.5 ppbv at Baton Rouge, LA (BRLA). Acetone concentrations ranged from 0.37 to 10.8 ppbv and averaged 1.8 ppbv over all sites. Site average acetone concentrations ranged from 0.68 ppbv at Houston, TX (H1TX) to 2.9 ppbv at Chicago, IL (C4IL). Author

N92-22217# National Marine Fisheries Service, Beaufort, NC.
METAL CONTAMINANT ASSESSMENT FOR THE SOUTHEAST ATLANTIC AND GULF OF MEXICO COASTS: RESULTS OF THE NATIONAL BENTHIC SURVEILLANCE PROJECT OVER THE FIRST FOUR YEARS 1984-1987
P. J. Hanson and D. W. Evans May 1991 218 p
(PB92-137835; NOAA-TM-NMFS-SEFSC-284) Avail: NTIS HC/MF A10 CSCL 13B

Sediment and fish tissue samples were collected annually for contaminant analysis as part of NOAA's National Status and Trends Program, National Benthic Surveillance Project since 1984. The goals of the project are: (1) to develop a nationally uniform, long-term data base for contaminants in US coastal areas; (2) to establish the current status and future trends in contaminant levels in sediments and fish; (3) to establish and monitor indicators of harmful effects to fish from contaminants, and (4) to provide information to control inputs, concentrations, and harmful effects of contaminants. Data are presented for concentrations of 16 elements (Ag, Al, As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, Si, Sn, Tl, and Zn) if fish livers and surficial sediments collected annually during 1984-87 along the southeastern Atlantic and Gulf of Mexico coasts at 17 locations. GRA

N92-22238*# State Univ. of New York, Stony Brook. Inst. for Terrestrial and Planetary Atmospheres.
SATELLITE OBSERVATION AND MAPPING OF WINTERTIME OZONE VARIABILITY IN THE LOWER STRATOSPHERE
Marvin A. Geller, Yuechen Chi, Richard B. Rood, Anne R. Douglass, Jack A. Kaye, and Dale J. Allen (Applied Research Corp., Landover, MD.) 1992 19 p
(Grant NAG5-1699)
(NASA-CR-190206; NAS 1.26:190206) Avail: NTIS HC/MF A03 CSCL 13B

Comparison is made between 30 mbar ozone fields that are generated by a transport chemistry model utilizing the winds from the Goddard Space Flight Center stratospheric data assimilation system (STRATAN), observations from the LIMS instrument on Nimbus-7, and the ozone fields that result from 'flying a mathematical simulation of LIMS observations through the transport chemistry model ozone fields. The modeled ozone fields were found to resemble the LIMS observations, but the model fields show much more temporal and spatial structure than do the LIMS observations. The 'satellite mapped' model results resemble the LIMS observations much more closely. These results are very consistent with the earlier discussions of satellite space-time sampling by Salby. Author

N92-22301# Forschungszentrum Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz.
INVESTIGATIONS OF ATMOSPHERIC SPREADING OF NOXIOUS MATTERS AFTER SHORT TIME EMISSIONS IN AN UNLEVEL TRACT OF LAND. SECOND INTENSIVE PHASE IN JUNE/JULY 1987 AND SPREADING EXPERIMENTS FROM 1 TO 12 JUNE 1987 UP TO JULY 1988 IN THE AREA OF SOPHIENHOHE (FED. REPUBLIC OF GERMANY) [UNTERSUCHUNGEN ZUR ATMOSPHAERISCHEN AUSBREITUNG VON SCHADSTOFFEN NACH KURZZEITEMISSIONEN IN NICHT EBENEM GELAENDE. ZWEITE INTENSIVMESSPHASE IM JUNI/JULI 1987 UND AUSBREITUNGSEXPERIMENTE 1-12 VON JUNI 1987 BIS JULI 1988 IM GEBIET DER SOPHIENHOEHE]
G. Zeuner, K. Heinemann, M. Moellmann-Coers, and C. Moenig May 1991 197 p In GERMAN Sponsored by Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit
(JUEL-2476; ISSN-0366-0885; ETN-92-91013) Avail: NTIS HC/MF A09

The experimentation area is described and the installation of different measuring systems is represented. The experimentation concept provides that the wind field is continually detected in a long duration measuring network. During the second intensive measuring phase, radiosondes with radar tracking and balloons were used. The meteorological measurements are described and topographic data are reported. Results of spreading experiments are given and discussed. ESA

N92-22310# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: EARTH SCIENCES. ECOLOGICAL CONSEQUENCES ON CHERNOBYL
23 Jan. 1992 48 p Transl. into ENGLISH of various Russian articles
(JPRS-UES-92-001) Avail: NTIS HC/MF A03

A bibliography is given of Centrai Eurasian earth sciences,

specifically the environmental consequences of the nuclear power reactor accident at Chernobyl. Topics covered include the physicomathematical simulation of the behavior of radionuclides, the radioactive pollution of the Dnepr Basin, plutonium in soils, the Chernobyl Forest, and the combined mapping of polluted territories. Author

N92-22488*# National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.
SUPPLEMENTAL FINAL ENVIRONMENTAL IMPACT STATEMENT FOR ADVANCED SOLID ROCKET MOTOR TESTING AT STENNIS SPACE CENTER
Aug. 1990 227 p
(NASA-TM-107818; NAS 1.15:107818) Avail: NTIS HC/MF A11 CSCL 13B

Since the Final Environmental Impact Statement (FEIS) and Record of Decision on the FEIS describing the potential impacts to human health and the environment associated with the program, three factors have caused NASA to initiate additional studies regarding these issues. These factors are: (1) The U.S. Army Corps of Engineers and the Environmental Protection Agency (EPA) agreed to use the same comprehensive procedures to identify and delineate wetlands; (2) EPA has given NASA further guidance on how best to simulate the exhaust plume from the Advanced Solid Rocket Motor (ASRM) testing through computer modeling, enabling more realistic analysis of emission impacts; and (3) public concerns have been raised concerning short and long term impacts on human health and the environment from ASRM testing. H.A.

N92-22604# Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
EVALUATION OF PILOT ESP PERFORMANCE WITH ELEVATED LOADINGS FROM SORBENT INJECTION PROCESSES
C. B. Sedman, R. E. Valentine, and N. Plaks 4 Sep. 1991 18 p Presented at the 9th Symposium on Particulate Control, Williamsburg, VA, 15-19 Oct. 1991
(PB92-113117; EPA/600/D-91/244) Avail: NTIS HC/MF A03 CSCL 13B

Given here are the results of pilot electrostatic precipitator (ESP) performance with elevated loadings from the advanced silicate (ADVACATE) sorbent injection process. Measurements were made of a calcium silicate sorbent injected into a duct upstream of an ESP. The concentration of ADVACATE sorbent submicron particles and projected ESP emissions tended to peak and begin to decrease when the overall particulate matter addition rate to the gas stream approached and then exceeded 12g/Nm3. The submicron fly ash, subjected to the same duct injection, increased linearly with increased injection rates from 3 to 24 g/Nm3. A possible explanation is in-duct agglomeration of fines by coarse particles, similar to observations reported on cyclone performance evaluations. The duct, flue gas, and sorbent characteristics that affect agglomeration tendencies probably play a major role in the observations presented. Most of the ADVACATE material settled out of the gas stream. Measurements of the gas suspended residual particulate matter were used to model expected ESP performance. The encouraging results of the modeling suggest that collection of reacted ADVACATE sorbent in an ESP is manageable.
Author

N92-22632# Regensburg Univ. (Germany, F.R.). Fakultaet fuer Chemie und Pharmazie.
GASCHROMATOGRAPHIC DETERMINATION OF HALOGENATED HYDROCARBONS IN THE ANTARCTIC ATMOSPHERE, IN SOUTH POLAR WATERS, AND IN ANTHROPOGENOUS LOADED AIR Ph.D. Thesis [GASCHROMATOGRAPHISCHE BESTIMMUNG HALOGENIERTER KOHLENWASSERSTOFFE IN DER ANTARKTISCHEN ATMOSPHAERE, IN SUEDPOLAREN GEWAESSERN SOWIE IN ANTHROPOGEN BELASTETER LUFT]
Werner Reifenhaeuser 1989 211 p In GERMAN
(ETN-92-91162) Avail: NTIS HC/MF A10

The analytical processes developed allowed the first time detection of various biogenous brominated and iodinated methane in the Antarctic atmosphere and in south polar waters. The examinations gave a first base data material on the source strength and concentration of brominated and iodinated species in the Antarctic. It is shown that further investigations are necessary for an exact understanding of the biogeochemical cycle of bromine and iodine elements. ESA

N92-22655# New Energy Development Organization, Tokyo (Japan).
INTRODUCTORY SURVEY FOR A LONG-TERM ENVIRONMENT MONITORING RELATED TO GEOTHERMAL ENERGY DEVELOPMENT (WILD ANIMALS), PART 1
Mar. 1991 125 p In JAPANESE; ENGLISH summary
(DE92-769384; NEDO-P-9010-Pt-1) Avail: NTIS HC/MF A06

An investigation and a study of the literature are conducted aiming at establishing methods for a long-term monitoring of environmental effects of geothermal energy development on wild animals. Introduced is the present status of geothermal power plants and an environmental assessment of geothermal energy development in Japan. Relating to geothermal development, factors and elements are summarized which impact on wild animals and their relations, and problems on environmental conservation. Methods for studiing wild animals assessment and studies of environmental assessment are outlined. The study of wild animals monitoring was conducted in Otake and Hatchobaru geothermal areas by NEDO entrusted to by Environment Agency and MITI, and monitoring examples in the study are summed up here. Methods of wild animals monitoring for geothermal energy development are considered, referring to and citing researches on natural environment monitoring methods by the Japan Highway Public Corporation. There are very few data and reports on wild animals environmental monitoring related to geothermal energy development. It is important to accumulate a lot of study examples and scientific knowledge and information to assess and monitor the environment for wild animals. DOE

N92-22656# New Energy Development Organization, Tokyo (Japan).
INTRODUCTORY SURVEY FOR A LONG-TERM ENVIRONMENT MONITORING RELATED TO GEOTHERMAL ENERGY DEVELOPMENT (WILD ANIMALS), PART 2
Mar. 1991 145 p Partly in JAPANESE; and ENGLISH
(DE92-769385; NEDO-P-9010-Pt-2) Avail: NTIS HC/MF A07

This study is conducted to make adequate observations on and evaluations of effects of geothermal energy development on the environment and to obtain a social consensus, aiming at promoting development of geothermal resources. The main report puts together the literature on the methods for monitoring and assessing wild animals for the purpose of establishing monitoring methods including environmental impacts by the investigation method in the stage of the investigation of geothermal resources conducted by NEDO. Seventy domestic and 25 foreign data sets are collected excluding the data cited in the main report. Looking closely into this literature, 32 domestic and 15 foreign reports are selected as data sets for references for this study. These reports are compiled into one book, each itemizing its author, theme, report title and main result. As mentioned in the main report, the literature on wild animals monitoring related to geothermal energy development is very few. Therefore, these data sets can be valuable. DOE

N92-22658# New Energy Development Organization, Tokyo (Japan).
SURVEY FOR IMPACTS OF GLOBAL ENVIRONMENTAL ISSUES ON UTILIZATION OF ALTERNATIVE ENERGIES FOR OIL
Mar. 1991 296 p In JAPANESE; ENGLISH summary
(DE92-769391; NEDO-P-9029) Avail: NTIS HC/MF A13

This paper makes analyses of what policy and technological option each advanced industrial country thinks to take as measures for the global warming problem, at the same time clarifying the

trends in international meetings. Analyses are also made of attitudes of developing countries and the international cooperation problem. Among the problems on global warming, an emphasis is placed on introduction of energy saving and what role the development of new energy plays. A positive group consisting mostly of West European countries is advocating a 'Go Quickly' approach, while the US representing a prudent group is developing a 'Go Slowly' approach. The US is considering afforestation which is useful to absorb CO2 and methane recovery as technological options. West European countries regard CO2 fixation as an important option. USSR, East European and developing countries consider that the most feasible and successful CO2 measures are energy saving/improvement of energy efficiency and forest administration/afforestation. DOE

N92-22382*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ENVIRONMENTAL INTERACTIONS IN SPACE EXPLORATION: ENVIRONMENTAL INTERACTIONS WORKING GROUP
Joseph C. Kolecki and G. Barry Hillard *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 785-787 Previously announced as N92-17069 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 13B

N92-22456*# Brookhaven National Lab., Upton, NY.
WASTE MANAGEMENT TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROGRAMS AT BROOKHAVEN NATIONAL LABORATORY
Paul D. Kalb and Peter Colombo *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 283-291 (For primary document see N92-22423 13-99)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC/MF A23 CSCL 13B

N92-22457*# Oak Ridge National Lab., TN. Environmental Sciences Div.
REGULATED BIOLUMINESCENCE AS A TOOL FOR BIOREMEDIATION PROCESS MONITORING AND CONTROL OF BACTERIAL CULTURES
Robert S. Burlage, Armin Heitzer, and Philip M. DiGrazia (Tennessee Univ., Knoxville.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 292-299 (For primary document see N92-22423 13-99)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A23 CSCL 13B

N92-22827# Meteorological Office, Bracknell (England).
REPORTS OF THE WORKING GROUPS: ENVIRONMENT. WHY OBSERVE THE EARTH'S ENVIRONMENT?
B. J. Mason *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 9-14 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22828# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
ATMOSPHERIC CHEMISTRY: INTRODUCTION. BRIEF INTRODUCTION TO ATMOSPHERIC CHEMISTRY
J. P. Burrows *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 15-23 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22829# Joint Research Centre of the European Communities, Ispra (Italy). Inst. for Remote Sensing Applications.
RESOURCE MANAGEMENT: INTRODUCTION
J.-P. Malingreau *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 24-33 (For primary document see N92-22826 13-42)
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N92-22833# Meteorological Office, Bracknell (England).
ENVIRONMENT: MONITORING AND PREDICTION OF THE GLOBAL ENVIRONMENT
B. J. Mason *In* ESA, Report of the Earth Observation User Consultation Meeting 71-73 (SEE N92-22826 13-42) Oct. 1991 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22834# Meteorological Office, Bracknell (England).
MONITORING CLIMATE AND CLIMATE CHANGE: CLIMATE CHANGE CONCERNS
J. Houghton *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 74-81 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22835# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
ATMOSPHERIC CHEMISTRY AND THE BIOSPHERE
P. Crutzen and G. Megie (Centre National de la Recherche Scientifique, Verrieres-Le Buisson, France) *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 82-89 (For primary document see N92-22826 13-42)
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N92-22836# Southampton Univ. (England).
PROCESSES AFFECTING THE ENVIRONMENT: OCEAN AND ATMOSPHERIC CIRCULATION
H. Charnock *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 90-93 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22840# Reading Univ. (England). Unit for Thematic Information Systems.
LAND-SURFACE PROCESSES: INTRODUCTION
J. Gurney *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 119-122 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22841# Alfred-Wegener-Inst. for Polar Research, Bremerhaven (Germany, F.R.).
ICE PROCESSES: INTRODUCTION
E. Augustein, P. Lemke, and T. Viehoff *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 123-129 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-22197 Reading Univ. (England).
GRAVITY WAVES AND WAVE DRAG IN FLOW PAST THREE-DIMENSIONAL ISOLATED MOUNTAINS Ph.D. Thesis
Pedro Manuel Alberto deMiranda 1990 205 p
Avail: Univ. Microfilms Order No. BRDX94425

A study was made of some aspects of stratified air flow past three dimensional isolated mountains. The study includes the development and validation of a three dimensional non-hydrostatic numerical model and its use in a number of simulations, the objective of which is the investigation of the behavior of the flow at small Frounde numbers (F = U/Nh) and in the presence of rotation and background shear. Some of the experiments simulate conditions typical of the flow over the Antarctic continent, for which nonlinear three dimensional effects are of paramount importance. The experiments described the variation of the gravity wave drag over a wide range of Froude numbers and indicate the existence of a transitional regime, between quasi-linear flow (for F greater than 1) and splitting flow (at F less than 0.5), which is characterized by wave breaking and quasiperiodic oscillations of the gravity wave drag. In the rotation experiments, the presence of downstream damped oscillations, trapped in the lower levels, is observed and attributed to resonance. In the experiments with shear, directional filtering is found to be an important effect in the upward propagation of internal gravity waves. Some effects associated with strongly stratified flow are also observed, namely upstream influence and barrier effects. Author

N92-22219# Computational Physics, Inc., Annandale, VA.
THEORETICAL SUPPORT TO NRL'S UPPER ATMOSPHERIC BRANCH: PHYSICS AND CHEMISTRY OF THE UPPER AND MIDDLE ATMOSPHERES WITH EMPHASIS ON DAYTIME, NIGHTTIME, AND AURORAL OPTICAL EMISSIONS Final Report, Jul. 1985 - Jul. 1988
Jun. 1991 201 p
(Contract N00014-85-C-2475)
(AD-A244584) Avail: NTIS HC/MF A10 CSCL 20/6

Significant advances were made in the ability to model physical processes in the thermosphere (airglow and aurora) and middle atmosphere. These advances came in the form of code development and improved methods for updating input parameters (most notably, cross sections). Important advances were also made in the development of an algorithm for deducing O3 and O2 density profiles from full solar disk extinction measurements to be made by the instrument Solar Ultraviolet Spectral Irradiance Monitor (SUSIM) on board the upper atmosphere research satellite (UARS). GRA

N92-22631# Technische Univ., Delft (Netherlands).
ANALYSIS OF PLASTICITY AND NON-COAXIALITY IN GEOMATERIALS Ph.D. Thesis
Johannes Antonius Ma Teunissen 1991 136 p Sponsored by Delft Geotechnics
(ETN-92-91145) Avail: NTIS HC/MF A07

A historical review of the institutive models used in geomechanics is presented. The differences between these models originate in either the fundamental mathematical or mechanical principles. The consequences of non-coaxiality of the principal direction of stresses and plastic strain rates is studied with respect to the mechanical formulation and its numerical simulation. The following are detailed: finite element formulation of boundary problems; formulation of double shearing for plasma strain conditions; analysis of double shearing with perfect plasticity; general theory of double shearing; and formulation of double shearing with hardening. ESA

N92-22669# Technische Univ., Delft (Netherlands). Geotechnical Lab.
NUMERICAL ANALYSIS OF SOIL-STRUCTURE INTERACTION Ph.D. Thesis
Harry vanLangen 1991 151 p
(ETN-92-91168) Avail: NTIS HC/MF A08

A study to improve some existing procedures for the finite element analysis of soil deformation and collapse is presented. Special attention is paid to problems of soil structure interaction. Emphasis is put on the behavior of soil rather than on that of structures. This seems to be justifiable if static interaction of stiff structures and soft soil is considered. In such a case nonlinear response will exclusively stem from soil deformation. In addition, the quality of the results depends to a high extent on the proper modeling of soil flow along structures and not on the modeling of the structure itself. An exception is made when geotextile reinforcement is considered. In that case the structural element, i.e., the geotextile, is highly flexible. The equation of continuum equilibrium, which serves as a starting point for the finite element formulation of large deformation elastoplasticity, is discussed with special attention being paid to the interpretation of some objective stress rate tensors. The solution of nonlinear finite element equations is addressed. Soil deformation in the prefailure range is discussed. Large deformation effect in the analysis of soil deformation is touched on. ESA

N92-22790# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
REMOTE SENSING OF THE PROPAGATION ENVIRONMENT
Feb. 1992 340 p In ENGLISH and FRENCH Symposium held Cesme, Turkey, 30 Sep. - 4 Oct. 1991
(AGARD-CP-502; ISBN-92-835-0654-5) Copyright Avail: NTIS HC/MF A15; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Increasing complexity and sophistication of modern military sensor and weapon systems require a more accurate and timely description of the propagation environment for the entire electromagnetic spectrum. Active and passive remote sensing techniques deployed from the ground, airborne platforms, and satellites offer the greatest potential for producing the desired information in a timely manner. The symposium addressed: (1) sensing tropospheric refractivity using propagation measurements and various other remote sensing techniques; (2) ionospheric sensing techniques and interpretation of remotely sensed signatures; (3) sensing of aerosols and other atmospheric parameters important for the propagation of visible and infrared radiation; (4) techniques to measure winds, temperature, liquid water, and humidity in the lower atmosphere; and (5) measurement, inversion, and processing techniques. For individual titles, see N92-22791 through N92-22825.

N92-22791# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
REMOTE SENSING OF REFRACTIVITY STRUCTURE BY DIRECT RADIO MEASUREMENTS AT UHF
Herbert V. Hitney *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p Sponsored by Office of Naval Technology (For primary document see N92-22790 13-46)
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A method is presented that allows the base of a trapping layer to be determined directly from observations of signal strength on a UHF path in the southern California coastal area. The method uses long-term statistics of trapping layer thickness and refractivity gradient in the area. These statistics are used to compute radio signal strength as a function of the base height of the trapping layer using the Naval Ocean Systems Center Radio Physical Optics (RPO) model. The radio path selected is an over-water 148 km path with transmitter and receiver both located 30 m above sea level. The RPO results are used to infer the trapping layer base height directly from observations of received signal strength. This method was applied to a 40-day period of continuous signal strength recordings during which the trapping layer base height was known to vary considerably from near zero to about 1000 meters. Inferred base height versus time is compared to direct meteorological measurements of the base of the temperature inversion in the area of the measurements. Author

N92-22792*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
SENSING PROPAGATION EVENTS AND FADE STATISTICS AT C-BAND FOR TWO OVER-WATER, LINE-OF-SIGHT PROPAGATION PATHS OVER A ONE YEAR PERIOD c32
Julius Goldhirsh, G. Daniel Dockery, and Bert H. Musiani *In* AGARD, Remote Sensing of the Propagation Environment Feb.

1992 12 p Sponsored by NASA. Wallops Flight Facility (For primary document see N92-22790 13-46)
(Contract N00039-89-C-0001)
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We examine signal fading statistics over a year period corresponding to two over-water, line-of-site, propagation links in the mid-Atlantic coast of the US. These links are comprised of a transmitter on a tower at Parramore Island, VA operating at 4.7 GHz sending simultaneous cw signals to two receiver systems located on a lighthouse and a lookout tower on Assateague Beach, VA at distances of 44 and 39 km, respectively. The receiving sites are separated by approximately 5 km. Cumulative fade distributions corresponding to yearly, monthly, and diurnal time scales were derived. Fade duration statistics correspond to sustained attenuation events were also derived. These events, which were arbitrarily defined as having fades relative to free space powers in excess of 20 dB for durations of two hours or more, are believed to be generally due to subrefraction. Analysis of synoptic weather conditions and nearby rawindsonde data during two sustained deep fading periods showed atmospheric conditions consistent with extreme subrefraction, where the refractivity-height profile had a positive lapse rate. The efficacy of employing the links as indicators of real time conditions of atmospheric propagation was also demonstrated by a telephone call-up procedure which enabled displays of time series of the fading at remote locations to be generated. Author

N92-22793# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
REMOTE SENSING OF THE EVAPORATION DUCT USING AN X-BAND RADAR
Kenneth D. Anderson *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p Sponsored by Office of Naval Technology (For primary document see N92-22790 13-46)
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Results from a unique analytical and measurement effort to assess low-altitude short-range radar detection capabilities in an evaporation ducting environment are presented. Although the measurement effort is ongoing, current results for unstable conditions validate propagation model predictions of reduced radar detection ranges within the radio horizon. In addition, discrepancies between measured and predicted radar data demand a close examination of both meteorological data and surface layer theory. At ranges near and beyond the horizon, radar detection capabilities crucially depend both on the surface layer refractivity profile and on the refractivity profile determined from upper-air observation. An empirical model to merge the surface layer with the mixed layer is discussed. Other discrepancies, which are thought to be caused either by inadequate surface layer modeling or by inadequate surface layer meteorological measurements, suggest the need for an improved surface layer model. Remote sensing of the evaporation duct by radar measurements is not a viable tactical tool. However, the combination of direct surface and upper-air meteorological measurements with remotely sensed radar measurements and with advanced numerical modeling capabilities does provide valuable insight for a better understanding of the atmospheric surface layer and its effects on low-altitude short-range radar detection. Author

N92-22794# Centre d'Electronique de l'Armement, Bruz (France). Div. ASRE.
OVER THE HORIZON PROPAGATION IN A MARINE ENVIRONMENT: MODELLING AND RECENT EXPERIMENTAL RESULTS **c32**
Jacques Claverie and Yvonick Hurtaud *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 14 p In FRENCH (For primary document see N92-22790 13-46)
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In the context of work undertaken by the Propagation subgroup AC 243/RSG8/com. III, two important series of measurements were taken in the neighborhood of the French coast: in the Atlantic (Lorient region) in the Fall of 1989, and in the Mediterranean (Toulon region) during the summer of 1990. These were measurements of over-the-horizon links above the sea, at a sweeping angle, with wavelengths in centimeters and millimeters (from 3 to 94 GHz). In order to precisely characterize the limit layer of the oceanic surface, meteorological measurements were undertaken using automatic stations on buoys placed near the line of sight and radiosondes suspended from balloons. The data set gathered enables the completion and validation of a program for global calculation of propagation in a marine environment. This program is constructed from a propagation model, based on the parabolic equation method and from an environment model developed based on a 'bulk' type procedure. Statistical analysis of the experimental data demonstrates the good quality of the combination of models used. The advantage of a multifrequency approach is also clearly shown. However, the temporal comparison between predicted and measured propagation losses proves to be more complex. An appreciable improvement can be made by taking into account the level of measurements taken and environmental models, complex atmospheric situations, and spatial discrepancies. Transl. by L.B.

N92-22795# Centre d'Etudes et de Recherches, Toulouse (France). Departement Micro-Ondes.
A THEORETICAL STUDY OF A RADIOWAVE CHARACTERIZATION METHOD OF THE EVAPORATION DUCT **c32**
N. Douchin, S. Bolioli, F. Christophe, and P. Combes (Toulouse Univ., France) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 15 p In FRENCH; ENGLISH summary (For primary document see N92-22790 13-46)
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The aim in this study is to consider the possibility of identifying the evaporation duct parameters from a fluctuation analysis of a near the horizon satellite-ship path. The latter is split in two different parts and reciprocity is applied. Thus, we get two different field distributions on a connecting interface which has to be suitable for a good calculation of the coupling between both of them. Then, the model is used with the intention of evaluating the fluctuations of the received signal due to the movement of the satellite and their sensitivity to the parameters of the propagation medium: sea roughness, height, and strength of the evaporation duct; and presence of horizontal gradients in the refractive index distribution. Obviously, sensitivity to these parameters is examined for several values of the frequency. Author

N92-22796# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
RADIO REFRACTIVITY PROFILES DEDUCED FROM AEROSOL LIDAR MEASUREMENTS **c32**
H. G. Hughes, M. R. Paulson, and J. H. Richter *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p Sponsored by Office of Naval Technology (For primary document see N92-22790 13-46)
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A technique is presented for estimating radio wave ducting conditions from shipboard curing cloud-free periods using a lidar system to measure the power from a pulsed laser beam that is backscattered to a receiver from suspended particulates (aerosols) at different ranges. On individual days, the relative humidity measured with altitude using radiosondes launched simultaneously with vertical lidar shots, were highly correlated with the range-compensated power received by the lidar from the same altitude. However, the relationship between the power returns and the relative humidities changed from day to day, indicating an air mass characteristic dependence on the aerosols' optical parameters. Using a combined data set of 13 days, a linear relationship (correlation = 0.73) was determined between the

relative humidity at a given altitude and the range-compensated power received by the lidar from the same altitude. While the magnitudes differed in most cases, the gradients in modified radio refractivity calculated using standard vertical lapse rates of temperature and pressure with the experimentally determined relationship were in close agreement with those calculated using the radiosonde measured parameters. Examples of radio signal coverage plots based on the lidar returns are presented and compared with those calculated from the radiosonde data for both elevated and ground-based ducting conditions. Author

N92-22797# Rutherford Appleton Lab., Chilton (England). Radio Communications Research Unit.

USE OF MESOSCALE MODELS FOR REFRACTIVITY FORECASTING **c32**

M. F. Levy and K. H. Craig *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 12 p Sponsored by Ministry of Defence (For primary document see N92-22790 13-46)

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Three-dimensional forecasts of sensor performance require accurate predictions of refractivity features. Numerical weather models like the UK mesoscale model have become sufficiently powerful to provide good refractivity maps. These in turn provide environmental input for parabolic equation models to forecast microwave propagation. The UK mesoscale model and its application to forecasting sensor performance are briefly described. Author

N92-22798# Pacific Missile Test Center, Point Mugu, CA.

REFRACTIVE ASSESSMENTS FROM SATELLITE OBSERVATIONS **c32**

Jay Rosenthal and Roger Helvey *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)

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Capabilities of estimating ducting conditions for certain ocean regions (and weather regimes) from meteorological satellite data are under development at the Pacific Missile Test Center, in support of the Navy's Electromagnetic Propagation Assessment and Tactical Environmental Support System (TESS) program offices. Visual imagery patterns are used to infer the occurrence, height, and intensity of ducts, while processed infrared (IR) and visual imagery are used to infer the spatial distribution of duct heights. Special cloud signature techniques were developed on a personal computer to help correct for contamination of cloud-top temperatures due to sea and cloud anomaly features which impact the IR-duct technique. Synoptic, mesoscale, and geographical influences on the propagation environment are considered as part of the effort to develop a predictive capability. Author

N92-22799# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA. Atmospheric Directorate.

A VIRTUAL SENSOR FOR EVAPORATION DUCTS: THE IMPACT OF DATA UNCERTAINTIES **c43**

John Cook *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p Sponsored by Space and Naval Warfare Systems Command (For primary document see N92-22790 13-46)

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For this application, virtually sensed data is defined as the output from a combination of satellite based remote sensing instruments that have been blended with data from a numerical weather prediction model/data assimilation system and processed by an algorithm. Such a 'virtual sensor' is described to assess evaporation ducts over marine regions. Here, the sensitivity of four evaporation duct height algorithms are examined and the results are expressed in terms of the duct height error versus parameter error. The data used was generated parametrically so that a large variation of environmental conditions could be considered. The errors imposed on the data represent uncorrelated random errors associated with satellite based remote sensing inaccuracies. The study shows that, although the evaporation duct height algorithms have different genealogies, they have similar sensitivities. The conclusions represent a best case scenario because of the omission of some sources of error and the assumption of horizontal homogeneity in the near-surface refractivity field over a typical satellite sensor footprint. Author

N92-22800# Royal Aircraft Establishment, Farnborough (England). Aerospace Div.

ROSE: A HIGH RESOLUTION, AMPLITUDE CODED, HIGH FREQUENCY OBLIQUE IONOSONDE

P. C. Arthur, A. H. Dickson, and P. S. Cannon *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 7 p (For primary document see N92-22790 13-46)

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A high quality high frequency oblique ionosonde was developed for use in propagation research and associated studies of the ionosphere. The ionosonde is known as ROSE (Radio Oblique Sounding Equipment) and requires the connection of a specially designed enhancement to a commercially available chirp sounder receiver (RCS-5) manufactured by the BR Corporation in the USA. Two important features are brought about by the addition of this enhancement. First is an increase in the resolution of an ionogram by a factor of approximately three. This allows the fine structure in the ionospheric returns to be detected. Second is color coding of the ionogram according to the amplitude of the received signal. Detailed mode amplitude information and comparisons of the relative strengths of propagating modes can be achieved. Additional features which are provided include display handling and data storage facilities. Author

N92-22801# Massachusetts Univ., Lowell. Center for Atmospheric Research.

THE NEW PORTABLE DIGISONDE FOR VERTICAL AND OBLIQUE SOUNDING

Bodo W. Reinisch, D. Mark Haines, and Walter S. Kuklinski *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 11 p (For primary document see N92-22790 13-46) (Contract F19628-90-K-0029)

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A small low cost digital ionosonde, the Digisonde Portable Sounder (DPS), was developed. It uses 500 microsecond, 10 percent duty factor, wide pulses for vertical sounding and 8.5 microsecond pulses for oblique sounding. Intrapulse coding and pulse compression techniques result in a 67 microsecond resolution for both waveforms. A new autoscaling technique for oblique ionograms inverts the oblique echo traces into midpoint electron density profiles that are modeled as a sum of quasiparabolic layers. Author

N92-22802# Illinois Univ., Urbana-Champaign. Dept. of Electrical and Computer Engineering.

SENSING THE IONOSPHERIC REFLECTION CHANNEL WITH A SOUNDER

K. C. Yeh and Haim Soicher (Army Communications-Electronics Command, Fort Monmouth, NJ.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p (For primary document see N92-22790 13-46)

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A sounder was designed and constructed to probe the ionosphere for channel properties. The sounder must be capable of probing the ionosphere for wideband response. The implemented sounder consists of a transmitter located in Platteville, Colorado and a receiver located in Urbana, Illinois, separated by a ground distance of 1401 km. The transmitter and receiver are both PC controlled to sound the ionosphere at 6 frequencies selectable by the experimenter in the range of 5 to 15 MHz. The sounder can

be commanded by a central PC in the laboratory to work in either the ranging mode or the probing mode. In the ranging mode, the time delay is measured; in the probing mode, the quadrature components (or amplitude and phase) are measured. Reported here are some experimental results obtained by using this sounder. Specifically, some properties of the time dependent transfer function of the channel are described. Author

N92-22803# Hull Univ. (England). Communications Research Group.

ADAPTIVE REMOTE SENSING OF THE IONOSPHERE TO MINIMISE SPECTRAL INTRUSION

M. Gallagher and M. Darnell *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 16 p Sponsored by Science Research Council; Roke Manor Research Ltd.; Siemens-Plessey Defence Systems; and RAE (For primary document see N92-22790 13-46)

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Suggested here is a rationale for future remote sensing systems, using as an example an economical sounding system that employs standard radio system elements. The proposed rationale is based upon a generic architecture which can maximize the information gathered with the minimal active radiation of EM energy. The system described can passively monitor the output from proprietary 'chirp' sounders; it also has the additional capability of radiating its own sounding signals to complement the information gathered from passive monitoring. The active sounding takes the form of a segmented swept FM (SSFM) system. The profile of the sounding signal is produced digitally and can take a number of formats, which include simple linear FM ('chirp') as well as other profiles that are inherently tolerant to other specific propagation problems that exist within the ionosphere; for example, the effects of Doppler shift can be minimized through the use of hyperbolic FM. The sounding system adaptively uses sequences that can sound the channels allocated to the communication system as well as frequency ranges of high importance, such as regions near to the maximum usable frequency (MUF) and the lowest usable frequency (LUF). The intelligent and adaptive use of such scanning techniques means that spectrum pollution is minimized, while the information gathered is maximized. Author

N92-22804# Illinois Univ., Urbana. Wave Propagation Lab.

A REVIEW OF VARIOUS TECHNIQUES FOR COMPUTERIZED TOMOGRAPHIC IMAGING OF THE IONOSPHERE

T. D. Raymund *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p (For primary document see N92-22790 13-46)

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By using some new tomographic techniques for ionospheric electron density imaging, it may be possible to inexpensively (relative to incoherent scatter techniques) image ionospheric electron density in a vertical plane several times per day. Here, the basic geometry of the problem is reviewed and various techniques are discussed. The satellite-receiver geometry used to measure the total electron content causes the data to be incomplete; that is, the measured data do not contain enough information to completely specify the ionospheric electron density distribution in the plane between the satellite and the receivers. Most of the proposed techniques include some method designed to overcome this problem. Applications of these techniques made to simulated and real data and the results are compared and discussed. Author

N92-22805# University Coll. of Wales, Aberystwyth. Dept. of Physics.

MAPPING ELECTRON CONTENT AND ELECTRON DENSITY IN THE SUB-AURORAL IONOSPHERE

I. K. Walker, S. E. Pryse, C. D. Russell, D. L. Rice, and L. Kersley *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 12 p Sponsored in part by National Radio Propagation Programme and Science Research Council (For primary document see N92-22790 13-46)

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Applications involving radio waves propagating through the ionosphere are subject to errors due to the effects of the medium. For several of these effects, the electron content along the propagation path is a key parameter. At high altitudes, steep gradients in electron content resulting from electron density variations in the vicinity of the ionospheric trough are of particular importance. Described here are two methods of mapping electron content and electron density in the sub-auroral ionosphere over northern Europe. The first experiment yields measurements of differential carrier phase from which estimates can be made of the total electron content as a function of latitude for each pass of the NNSS satellites monitored. Calibration to obtain absolute values is achieved using spot data from a co-located receiving system for Global Positioning System (GPS) satellites or by means of ionosonde foF2 values and a slab thickness model. Results are presented illustrating behavior of the ionospheric trough. A second experimental campaign used the simultaneous observations of the NNSS satellites at four stations covering a latitudinal range of some 8 degrees. The resulting measurements of electron content from some 30 satellite passes were used in a reconstruction algorithm to map the electron density on a two dimensional grid. The potential usefulness of tomographic techniques in ionospheric sensing is discussed in light of the results obtained. Author

N92-22806# Netherlands Foundation for Radio Astronomy, Dwingelo.

IONOSPHERE AND TROPOSPHERE SEEN THROUGH A RADIO INTERFEROMETER

T. A. Th. Spoelstra *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p Sponsored by Netherlands Organization for Applied Scientific Research TNO (For primary document see N92-22790 13-46)

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Very Long Baseline Interferometry (VLBI) is sensitive to integrated effects along the line of sight. Provision of high quality information about the characteristics of the propagation environment is, therefore, inherent to this technique. The way this technique is generally used also enables the determination of these characteristics with a high time resolution, which makes it useful for the study of irregularities in the medium. Described here are the possibilities and limitations of this technique for ionospheric sensing and sensing of tropospheric refractivity. This technique is compared to some others used to derive the same information. The requirements for data handling and processing techniques are described, as well as the available 'tools'. Author

N92-22807# Illinois Univ., Urbana-Champaign. Dept. of Electrical and Computer Engineering.

RADAR INTERFEROMETRIC TECHNIQUES FOR INVESTIGATING FIELD-ALIGNED IONOSPHERIC PLASMA IRREGULARITIES

F. Surucu and E. Kudeki *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)

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One-dimensional interferometric radar systems with receiver baselines directed in magnetic north-south and east-west directions were used to study the anisotropy and inhomogeneity characteristics of ionospheric irregularities. In equatorial electrojet aspect sensitivity measurements conducted at Jicamarca, angular spectrum widths as small as approx. 0.05 degrees were resolved. The cross field structures and dynamics of electrojet irregularities were investigated using an interferometric imaging technique. Author

N92-22808# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.
ACTIVE REMOTE SENSING OF THE IONOSPHERE AND THE EARTH SURFACE IRREGULARITIES
Ezekiel Bahar *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 12 p (For primary document see N92-22790 13-46)
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Rigorous analyses of complex propagation problems necessitate the use of complete electromagnetic field expansions in three dimensions, the imposition of exact boundary conditions and the application of precise analytical procedures. The complete modal expansion of the horizontally and vertically polarized electromagnetic fields (Transverse Electric and Transverse Magnetic) consists of the radiation term, the lateral wave term, and the trapped waveguide modes. The tangential components of the electric and magnetic fields must be continuous at each of the interfaces of the irregular stratified media. Since the field expansions do not necessarily converge uniformly on the irregular boundaries of the stratified media, Green's theorems should be used to avoid interchanging orders of integration (summation) and differentiation. The 'full wave' procedures are used to convert Maxwell's equations into sets of generalized telegraphists' equations for the forward and backward propagating wave amplitudes. Author

N92-22809# Naval Ocean Systems Center, San Diego, CA.
SENSING OF ELF SIGNATURES ARISING FROM SPACE VEHICLE DISTURBANCES OF THE IONOSPHERE
Jack Y. Dea, William VanBise, Elizabeth A. Rauscher, and Wolfgang-Martin Boerner (Illinois Univ., Chicago.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 11 p (For primary document see N92-22790 13-46)
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Observations of Extremely Low Frequency (ELF) signatures during exit or reentry of space vehicles through the ionosphere are presented. The two modes regularly observed gave signals that peaked at 5.6 Hz and 11.2 Hz. The evidence points to the lower ionosphere, i.e., the D- and E-layers, as the generator of the signals. The measurements were performed using ground-based multi-turn coil sensors located in Reno and San Diego. The nature of these signals is unclear at present but it is surmised that we are detecting either the evanescent fields of hydromagnetic waves traveling in the ionosphere or the oscillating geomagnetic field associated with these hydromagnetic waves. Author

N92-22810# Naval Ocean Systems Center, San Diego, CA.
SENSING OF SEISMO-ELECTROMAGNETIC EARTHQUAKE PRECURSOR RADIATION SIGNATURES ALONG SOUTHERN CALIFORNIA FAULT ZONES: EVIDENCE OF LONG DISTANCE PRECURSOR ULF SIGNALS OBSERVED BEFORE A MODERATE SOUTHERN CALIFORNIA EARTHQUAKE EPISODE
Jack Y. Dea, Charles I. Richman, and Wolfgang-Martin Boerner (Illinois Univ., Chicago.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 8 p Previously announced in IAA as A92-17553 (For primary document see N92-22790 13-46)
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Observations of broadband ULF signals before and after an earthquake are presented. The particular quake in question was the Upland quake of 17 Apr. 1990, which was centered 200 km north of San Diego. The signals were detected with the vertically oriented search coil sensor and not with the horizontally oriented sensors, which suggests a disturbed ionosphere as the most likely source of these signals. The large prequake ULF activity, the rapid decay of ULF activity after the quake, and the absence of any geomagnetic storms indicate a good correlation of the ULF activity with the Upland quake. An interpretation of radio observations of seismic activity is presented and extended to earthquake precursor studies. Author

N92-22811# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
REMOTE SENSING OF AEROSOL EXTINCTION USING SINGLE-ENDED LIDARS
J. H. Richter, H. G. Hughes, and M. R. Paulson *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 5 p Sponsored by Office of Naval Technology (For primary document see N92-22790 13-46)
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A review is presented of past efforts to determine atmospheric extinction from single-ended lidar measurements of backscatter, and the assumptions made concerning the backscatter/extinction relationships. The degree to which the aerosols within the convectively mixed atmosphere can be expected to be horizontally homogeneous is also discussed. The conclusions are that unless the extinction/backscatter relationship is known, or that the atmosphere is horizontally homogeneous over the propagation path, the accuracies of extinction coefficients determined by a single-ended lidar cannot be assured. D.R.D.

N92-22812# Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, The Hague (Netherlands). Physics and Electronics Lab.
PROBING OF THE ATMOSPHERE WITH LIDAR
G. J. Kunz *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 11 p (For primary document see N92-22790 13-46)
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Lidar (optical radar) is a generally accepted technique which is used for remote sensing of atmospheric properties over ranges of kilometers to within a few microseconds. Different inversion techniques used to derive the required information from the lidar signal are discussed. The lidar properties determine which kind of information can be obtained. An overview of results obtained with two different lidar systems is presented. The results include the assessment of the systems, long term studies of the vertical infrared structure of the atmosphere, and fast dynamic processes. D.R.D.

N92-22813# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
LIDAR REMOTE SENSING TECHNIQUES FOR DEVELOPING AND EVALUATING ATMOSPHERIC AEROSOL MODELS
D. R. Jensen, H. G. Hughes, and M. R. Paulson *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p Sponsored by Office of Naval Technology (For primary document see N92-22790 13-46)
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A technique was developed by which lidar (optical radar) returns can be used to adjust simultaneously observed/modeled aerosol size distributions to represent existing atmospheric conditions. The technique was used to evaluate the U.S. Navy Maritime Aerosol Model (NAM) and the U.S. Navy Oceanic Vertical Aerosol Model (NOVAM). The evaluation of NOVAM indicated that, when scaled to visibility, good agreement exists between the lidar scaled extinction and backscatter coefficients and the predicted profiles. While adjustments of the NAM aerosol number densities can be made to match the modeled S(R) profiles to that measured by lidar in the first few meters above the surface of the ocean, the large adjustments for low wind speed indicates that the modeled aerosol size distribution shape near the ocean surface may not be correct. D.R.D.

N92-22814# Atmospheric Sciences Lab., White Sands Missile Range, NM.

FAR-INFRARED CHARACTERIZATION OF HORIZONTAL PATH IMAGE DEGRADATION **c32**

Wendell R. Watkins *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 11 p (For primary document see N92-22790 13-46)

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Recent measurements by the Mobile Imaging Spectroscopy Laboratory (MISL) have shed new light on the real degradation produced by atmospheric propagation on far-infrared imaging systems. By the hot and cold bars and the unique measurement technique of closeup and distant simultaneously collected matched imagery of a large area blackbody target board, the atmospheric modulation transfer function (AMTF) was shown to be definitely nonzero for both atmospheric horizontal path turbulence and aerosol clouds. In addition, observations of the target board without the bar pattern and uniform backgrounds were used to compare the MISL measured contrast transmission with LOWTRAN calculations. D.R.D.

N92-22815# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Inst. of Optoelectronics.

COMPACT LASER DOPPLER ANEMOMETER **c35**

Ch. Werner, M. Klier, H. Herrmann, E. Biselli, and R. Haering *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 7 p (For primary document see N92-22790 13-46)

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Wind profiles in the atmospheric boundary layer are a very important parameter in the study of atmospheric exchange processes. A small laser Doppler anemometer was designed, constructed, and tested. The system consists of the laser Doppler anemometer mounted on a pedestal and controlled by a personal computer. A sine wave fitting computer program is used to get the wind velocities and wind direction for the selected levels. This sophisticated program can distinguish between cloud and aerosol signals and also uses the azimuthal angle-velocity for extracting the direction of the wind. D.R.D.

N92-22816*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

REMOTE SENSING OF THE ATMOSPHERE BY MULTI-CHANNEL RADIOMETERS

Faramaz Davarian *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 8 p Sponsored by NASA, Washington (For primary document see N92-22790 13-46)

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To characterize Earth/space communication links, the Jet Propulsion Laboratory's (JPL's) Radiowave Propagation Program supports a number of propagation studies. Low-availability satellite links and their propagation vagaries at Ka and millimeter-wave bands constitute a major effort within this program. Since 1987, this program has funded the Wave Propagation Laboratory (WPL) of the National Oceanic and Atmospheric Administration (NOAA) to conduct multiple-frequency radiometric observations of the atmosphere. Measurements of atmospheric emission and attenuation at 20, 31, and 90 GHz at different locations are presented. Single-station and joint-station statistics are derived. A linear regression scheme for the prediction of fade statistics in one channel using fade data from the other two channels is presented. Author

N92-22817# Atmospheric Sciences Lab., White Sands Missile Range, NM.

OPTICAL REFRACTION IN THE ATMOSPHERIC SURFACE LAYER

James B. Gillespie and David H. Tofsted *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 7 p (For primary document see N92-22790 13-46)

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The nature was studied of atmospheric refraction and criteria was developed when refraction may cause errors in tank gunnery in deserts. Refraction can be remotely sensed as a function of time through point to point measurements of the elevation of a distant object relative to the atmospheric neutral events that occur approximately 1/2 hr before sunset and 1/2 hr after sunrise. The vertical position change of a distant object can be measured using either another object close enough to the observer that effects will be minimal (thus providing a fixed reference point) or a theodolite that has its own internal reference through the leveling bubble. Extensive measurements were made of diurnal variations in elevation of distant objects at White Sands Missile Range (WSMR), NM. Lessons learned from these experiments include accounting for numerous potential error sources when taking readings using theodolites and the photographic techniques necessary to cope with changing light levels and atmospheric turbulence effects. Measurements were made at other locations that exhibit similar vertical shifting characteristics. A surface energy budget model was developed to predict refraction situations based on meteorological measurements. Author

N92-22818# Atmospheric Sciences Lab., White Sands Missile Range, NM.

INVERTING RADIOMETRIC MEASUREMENTS WITH A NEURAL NETWORK

Edward M. Measure, Young P. Yee, Jeff M. Balding, and Wendell R. Watkins *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)

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A neural network scheme for retrieving remotely sensed vertical temperature profiles was applied to observed ground based radiometer measurements. The neural network used microwave radiance measurements and surface measurements of temperature and pressure as inputs. Because the microwave radiometer is capable of measuring 4 oxygen channels at 5 different elevation angles (9, 15, 25, 40, and 90 degs), 20 microwave measurements are potentially available. Because these measurements have considerable redundancy, a neural network was experimented with, accepting as inputs microwave measurements taken at 53.88 GHz, 40 deg; 57.45 GHz, 40 deg; and 57.45, 90 deg. The primary test site was located at White Sands Missile Range (WSMR), NM. Results are compared with measurements made simultaneously with balloon borne radiosonde instruments and with radiometric temperature retrievals made using more conventional retrieval algorithms. The neural network was trained using a Widrow-Hoff delta rule procedure. Functions of date to include season dependence in the retrieval process and functions of time to include diurnal effects were used as inputs to the neural network. Author

N92-22819# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.

CLEAR-AIR WIND PROFILERS AS CLOUD MONITORS AND HYDROMETEOR IDENTIFIERS **c47**

E. E. Gossard, S. Y. Matrosov, R. G. Strauch, and D. C. Welsh (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p (For primary document see N92-22790 13-46)

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Clear air sensing radars, which are used for wind sounding from surface platforms, are now widely deployed. They are usually designed to measure the Doppler sensed movement of clear air refractive index inhomogeneities, but they also provide an excellent tool for sensing ice and water particles in clouds. These radars usually have a very low detection threshold and long averaging time so that size distributions of particles as small as 100 micrometer diameter with mean vertical fall velocities (V sub f) as

small as 0.2/ms can be accurately measured. Data is presented from two events in which clouds form, intensify, and finally produce precipitation. Height profiles are displayed and analyzed as ZRV sub f plots vs. height, where Z is the radar reflectivity factor, R is liquid flux (rain), and V sub f is the mean fall velocity in quiet air derived from the radar measured vertical velocity. It is shown how these radars can provide (1) cloud layer structure above lower overcast; (2) height profiles of liquid mean drop size; (3) the ice water transition level compared with the 0 deg isotherm; (4) height profiles of rain rate; and (5) inferences about the identity of hydrometeors vs. height. Author

N92-22820# Forschungsinstitut der Deutschen Bundespost, Darmstadt (Germany, F.R.).

DIGITAL CHANNEL SOUNDER FOR REMOTE SENSING OF SCATTERERS IN MOBILE RADIO ENVIRONMENT **c32**

Rudolf Werner Lorenz and Gerhard Kadel *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)

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A channel sounder called RUSK 400 is described. It is capable of recording complex impulse responses (IRs) in mobile environment. Thanks to digital signal processing, RUSK 400 measures IRs with large dynamic range. RUSK 400 was calibrated to allow for quantitative analysis. Doppler analysis of the measured results can be performed because the data are stored rapidly, and therefore, the sampling theorem can be fulfilled. For determination of delays, the resolution is restricted to about 5 microns because of the small bandwidth of only 400 kHz. The resolution is good enough to perform propagation measurements with the goal of improving of propagation models which use topographical terrain data bases. The determination of angles of arrival is restricted; reasons are given and discussed. The shortcomings of poor resolution and left-right ambiguity can be overcome if it is possible to measure complex IRs at the same location by driving in different directions. RUSK 400 will be used for quantitative determination of magnitudes of waves scattered by terrain slopes. The results will be used to improve automatic field strength prediction methods and estimation of the delay spread caused by mountains. Author

N92-22821# Illinois Univ., Chicago. Communications and Sensing Lab.

BASIC EQUATIONS OF RADAR POLARIMETRY AND SOLUTIONS THE SENSING OF PROPAGATION PATH POLARIZATION STATE CHANGES **c32**

Wolfgang-Martin Boerner, Wei-Ling Yan, An-Qing Xi, and Yoshio Yamaguchi (Niigata Univ., Japan) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 9 p (For primary document see N92-22790 13-46)

(Contracts N00014-80-C-0773; N00014-90-J-1405; DAAL03-89-K-0116)

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Basic principles of radar polarimetry are introduced. The target characteristic polarization state theory is developed first for the coherent case using the three step, the basic transformation, and the power (Mueller) matrix optimization procedures. Kennaugh's and Huynen's theories of radar target polarimetry are verified for the monostatic reciprocal case. It is shown that there exist in total five unique pairs of characteristic polarization states for the symmetric scattering matrix of which the two pairs, the cross polarization null and copolarization max pairs, are identical; whereas, the cross pol max and the cross pol saddle point are distinct. These three pairs of orthogonal characteristic states are also mutually orthogonal on the polarization sphere. The fifth pair, the co-pol null pair lies in the plane spanned by the co-pol max/-cross pol null and the cross pol max pairs which determines the target characteristic circle on the polarization sphere reestablishing Huynen's polarization fork concept. The theory is verified by an example for which next to the polarization fork also the copolarized and cross polarized power density plots are presented. Author

N92-22822# Niigata Univ. (Japan). Faculty of Electronics.

ADAPTIVE COMMUNICATIONS POLARIMETRY: SENSING OF PROPAGATION PATH CHANGES AND ADAPTATION TO OPTIMAL PERFORMANCE IN CELLULAR COMMUNICATIONS **c32**

Yoshio Yamaguchi, Hyo Joon Eom, and Wolfgang-Martin Boerner (Illinois Univ., Chicago.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)

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Basic principles of radar polarimetry are applied to radio communications under the conditions that the polarization state of the incoming wave changes according to effects caused by the propagation environment. Since the polarization state of an incoming wave cannot be controlled, the only possible way to control the receiving power is the polarization state of the receiving antenna. Based on basic principles of radar polarimetry, the matching and mismatching conditions are derived using the Poincare sphere. An interesting relation was found between the maximal and minimal polarization states with respect to that of the incoming wave, i.e., these points constitute a great circle on the Poincare sphere and that they form a right angle triangle on the great circle. Therefore, if the polarization of the incoming wave is given, these maximal and minimal polarization points can be determined graphically on the Poincare sphere instantaneously. This concept of adaptive communications polarimetry may be useful not only to cellular radio communication systems, but to fixed station link radio communication systems suffering from atmospheric fluctuations as well. Author

N92-22823# Atmospheric Sciences Lab., White Sands Missile Range, NM.

ANALYSIS ALGORITHMS FOR PROCESSING ULTRAVIOLET FLUORESCENCE DATA **c36**

J. B. Gillespie, D. L. Rosen, Y. P. Yee, and R. Gonzales *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)

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Laser induced fluorescence (LIF) lidar is a promising technique for remote chemical detection and analysis for both hard targets and extended atmospheric targets dispersed as aerosols or gases. The fluorescence spectra of the hard targets and of the aerosols and gases in the troposphere are primarily very broad and devoid of sharp line structure. When several species are present, the resulting overlapped spectrum is difficult to analyze. Interpretation of the multicomponent spectra of the lidar signal return is necessary for application of an UV lidar in a complex atmospheric environment such as a modern battlefield. Algorithms are described that were developed to process UV lidar fluorescence data and to analyze for chemical components. The analysis algorithms are based on factor analysis rank annihilation (FARA) techniques. Four methods are applied to lidar systems modeling and simulation analysis that contains both shot noise and sky radiance. The limitations are shown of UV lidar systems in terms of range, daytime/nighttime operation, and lidar system parameters. It was found that for situations in which several constituents are fluorescing and have close overlap, sky radiance limits nighttime use. Author

N92-22824# Technische Hogeschool, Delft (Netherlands). Faculty of Electrical Engineering.

RECENTLY IMPLEMENTED WEATHER RADAR DATA PROCESSING TECHNIQUE FOR RAIN CELL MODELLING AND GROUND CLUTTER DETECTION **c47**

Y. Korbay and L. Ligthart *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)

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Throughout the last two decades, dramatic changes have been taking place in the field of radar meteorology. The effects of modern digital signal processing techniques should be especially considered. These new technologies present new opportunities in the weather radar research arena. Real-time processing is at present the key problem in this field, because by nature, meteorological targets are distributed in space and occupy a large portion of the spatial resolution cells observed by radar. For this reason, meteorological radars require high data rate recording and effective real-time processing. To solve the data handling and processing problems for weather surveillance radars, a method was initiated. The method makes use of a 'Framing based Radar Data Analysis'. The method shows great potential in the field of rain cell modeling and ground clutter suppression. The first verifications were performed using the off-line experimental data obtained from the operational Delft radar SOLIDAR. Author

N92-22825# Centre National d'Etudes des Telecommunications, Lannion (France).
A CALIBRATION TECHNIQUE FOR THE CNET HF BACKSCATTER RADAR **c32**
N. Ruelle, F. Gauthier, J. Y. LeSaout, L. Bertel, and V. Baltazart (Rennes Univ., France) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)
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A calibration procedure is described which is used in conjunction with the CNET HF backscatter radar at Losquet Island, France. This procedure characterizes the capability of the radar to determine angles of arrival of echoes by beam scanning. Author

N92-22830# Belgian Royal Observatory, Brussels.
SOLID EARTH: THE PRIORITIES
P. Paquet *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 34-39 (For primary document see N92-22826 13-42)
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N92-22850# Technische Univ., Delft (Netherlands).
SOLID EARTH: INTRODUCTION
R. Rummel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 209-213 Original contains color illustrations (For primary document see N92-22826 13-42)
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N92-22852# Bologna Univ. (Italy).
EARTH PHYSICS: STATE-OF-THE-ART AND MAIN ISSUES
S. Zerbini *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 220-225 (For primary document see N92-22826 13-42)
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N92-22853# Paris VI Univ. (France). Inst. de Physique du Globe.
MAGNETIC FIELD
J. Achache *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 226-239 (For primary document see N92-22826 13-42)
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47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-22178 Saint Louis Univ., MO.
STRUCTURE AND INTERNAL DYNAMICS OF A SUBTROPICAL SQUALL LINE DETERMINED FROM TAMEX DUAL-DOPPLER DATA Ph.D. Thesis
Hsi Shen 1991 196 p
Avail: Univ. Microfilms Order No. DA9131027

Structure features of a subtropical squall line that occurred on May 17, 1987 over the Taiwan Straits was investigated using the Taiwan Mesoscale Experiment (TAMEX) dual-Doppler data. Fields of the storm-relative wind and reflectivity were derived in the horizontal domain of 60 km by 40 km using a 1 km grid spacing. Vertical velocities were computed from the anelastic continuity equation by integrating downward with variational adjustment. Fields of perturbation pressure and temperature were then derived from the Doppler derived winds using the three momentum equations. Results show that many structural features of a subtropical squall line are similar to those for a fast-moving tropical squall line. A low level jet (LLJ) associated with the frontal system provides the necessary strong shear at low levels. The retrieved pressure and temperature perturbations are in good agreement with the updraft-downdraft structure. The interaction between the convective updraft and downdraft plays an important role in maintaining the three-dimensional circulation within the squall line. Budget calculations of momentum, momentum flux, and total kinetic energy all reveal interesting findings, which are consistent with the structure and internal dynamics of the squall line. Results of the momentum-flux budget agree well with those of a tropical convective line and a convective rain-band in the Arabian Sea. Dissert. Abstr.

N92-22185 Wisconsin Univ., Madison.
THE IRROTATIONAL AND ROTATIONAL KINETIC ENERGY BALANCE IN ISENTROPIC COORDINATES DURING THE GLOBAL WEATHER EXPERIMENT BOREAL WINTER Ph.D. Thesis
Steven Richard Silberberg 1991 228 p
Avail: Univ. Microfilms Order No. DA9126445

Analysis of the irrotational and rotational kinetic energy balance employing isentropic transport equations was conducted. The purpose of this research was to investigate the relation between the global distribution of heat sources and sinks, thermally forced isentropic mass circulation, and the maintenance of the planetary circulation kinetic energy balance. By partitioning kinetic energy into irrotational and rotational components, the direct effect of heat sources and sinks is coupled to irrotational kinetic energy generation. Conversion between irrotational and rotational kinetic energy is studied and frictional dissipation is estimated by the residual method. The results of this study are consistent with regard to available potential energy generation in midlatitude storms with heating occurring at higher pressure and infrared cooling occurring at lower pressure on isentropic surfaces. An implication of these results is that oceanic heat transport and latent and sensible heat flux to the atmosphere are important for the maintenance of the atmospheric circulation below 300 K. Dissert. Abstr.

N92-22225# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
LAKE ONTARIO WINTER STORMS (LOWS) PROJECT
R. F. Reinking, R. A. Kropfli, B. E. Martner, B. Orr, and J. B. Snider Nov. 1991 156 p
(PB92-133784; NOAA-TM-ERL-WPL-216) Avail: NTIS HC/MF A08 CSCL 04B

Snowstorms generated over the Great Lakes bring severe weather to areas inland from leeside shores. Localized but prolonged and extremely heavy precipitation, and blizzard conditions including the hazardous whiteouts, are characteristic of lake-effect snowstorms. Hazardous freezing rain often affects the same region in winter. The field phase of the Lake Ontario Winter Storms (LOWS) project was conducted in the eastern Lake Ontario basin between 5 Jan. and 1 Mar. 1990. The purpose of LOWS

was to examine possibilities for application of new remote sensing technologies to improve mesoscale monitoring and location-specific prediction of freezing rain and lake-effect storms. GRA

N92-22236# National Weather Service, Salt Lake City, UT.
CREATING MOS EQUATIONS FOR RAWS STATIONS USING DIGITAL MODEL DATA
D. D. Gettman Dec. 1991 22 p
(PB92-131473; NOAA-TM-NWS-WR-216) Avail: NTIS HC/MF A03 CSCL 04B

Model output statistics (MOS) forecasts of temperature, dew point, winds, clouds, and precipitation for major population centers throughout the U.S. have been available for many years. MOS forecasts offer little or no guidance to the fire weather meteorologist in the West. His task is to provide forecasts of temperature, dew point, winds, clouds, and precipitation. During the past 10 years, various land management agencies have purchased remote automated weather stations (RAWS) and sited them throughout the remote regions of the West. The goal was to produce forecasts of the RAWS observation parameters (temperature, wind, dew point, and fuel moisture) at 3-hour intervals, just as it was available for valley sites in the LFM-MOS guidance (FPC) messages on AFOS. The methods used at the Weather Service Office (WSO) Medford to collect the data, process the data, and produce forecasts are described. GRA

N92-22640# European Space Agency, Paris (France).
STUDY OF THE RETURN-STROKE PHASE OF A GLIDING SPARK IN AMBIENT AIR Ph.D. Thesis - Paris-Sud Univ., 1989
Frank Boulanger (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) Nov. 1991 172 p Transl. into ENGLISH of Etude de la Phase d'Arc en Retour d'une Etincelle Glissante dans l'Air a la Pression Atmospherique (Paris, France, ONERA), Apr. 1990 164 p Original language document was announced as N91-11345
(ESA-TT-1232; ONERA-NT-1990-1; ETN-92-91205) Avail: NTIS HC/MF A08

The so-called return stroke phase of lightning immediately follows the contact of the leader with the ground. An intense current wave climbs back towards the cloud along the route taken by the leader, with a speed of the order of c/10 to c/3. The phenomenon is reproduced in the laboratory by placing a (10 nF to 100 kV) capacitor at the end of a quasi-linear gliding spark. The distribution of potential along the discharge is measured with capacitive probes and the hydrodynamic expansion of the channel is made visible by holographic interferometry. A numerical model formulated from the Navier-Stokes equations is in qualitative agreement with the measurements. ESA

N92-22661* Oklahoma Univ., Norman. Cooperative Inst. for Mesoscale Meteorological Studies.
DROP SIZE SEPARATION AS A MECHANISM OF WARM RAIN FORMATION Abstract Only
Yefim L. Kogan 1991 1 p
(Grant NAG5-1528)
(NASA-CR-190221; NAS 1.26:190221) Avail: Issuing Activity CSCL 04B

The three dimensional nonhydrostatic anelastic model with explicit formulation of warm rain microphysical processes was used to study the flow structure of a convective cloud that evolves in an environment with a temperature stratification capped by an inversion layer. It is shown that two flow regimes in and around the cloud can be clearly distinguished: the first is formed by the jet stream below the inversion layer; and the second, by the return flow into the cloud. The large flow divergence at upper levels of the cloud and its separation into two different regimes lead to an interesting effect that may be called drop size separation or filtering. It is shown that cloud droplets with different sizes move along different trajectories. As a result, the small droplets are carried away from the cloud, while the large droplets will be recycled. The significance of these process is in the fact that large droplets will be brought back into the cloud in much smaller concentrations and, therefore, continue to grow under large supersaturations. Evidently, the filtering of the small droplets will result in enhanced condensational growth of recycled drops and facilitate coalescence initiation. Author

N92-22974# Sandia National Labs., Albuquerque, NM.
AN OVERVIEW OF THE YUCCA MOUNTAIN GLOBAL/REGIONAL CLIMATE MODELING PROGRAM
R. P. Sandoval, Y. K. Behl, and S. L. Thompson 10 Jan. 1992 8 p Presented at the International High Level Radioactive Waste Management (IHLRWM) Conference: Promoting Understanding Through Education and Communication, Las Vegas, NV, 12-16 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-006807; SAND-91-1927C; CONF-920430-40) Avail: NTIS HC/MF A02

The US Department of Energy (DOE) has developed a site characterization plan (SCP) to collect detailed information on geology, geohydrology, geochemistry, geoengineering, hydrology, climate, and meteorology (collectively referred to as 'geologic information') of the Yucca Mountain site. This information will be used to determine if a mined geologic disposal system (MGDS) capable of isolating high-level radioactive waste without adverse effects to public health and safety over 10,000 years, as required by regulations 40 CFR Part 191 and 10 CFR Part 60, could be constructed at the Yucca Mountain site. Forecasts of future climate conditions for the Yucca Mountain area will be based on both empirical and numerical techniques. The empirical modeling is based on the assumption that future climate change will follow past patterns. In this approach, paleclimate records will be analyzed to estimate the nature, timing, and probability of occurrence of certain climate states such as glacials and interglacials over the next 10,000 years. For a given state, key climate parameters such as precipitation and temperature will be assumed to be the same as determined from the paleoclimate data. The numerical approach, which is the primary focus of this paper, involves the numerical solution of basic equations associated with atmospheric motions. This paper describes these equations and the strategy for solving them to predict future climate conditions around Yucca Mountain. DOE

N92-22819# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
CLEAR-AIR WIND PROFILERS AS CLOUD MONITORS AND HYDROMETEOR IDENTIFIERS
E. E. Gossard, S. Y. Matrosov, R. G. Strauch, and D. C. Welsh (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 10 p (For primary document see N92-22790 13-46)
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N92-22824# Technische Hogeschool, Delft (Netherlands). Faculty of Electrical Engineering.
RECENTLY IMPLEMENTED WEATHER RADAR DATA PROCESSING TECHNIQUE FOR RAIN CELL MODELLING AND GROUND CLUTTER DETECTION
Y. Korbay and L. Ligthart *In* AGARD, Remote Sensing of the Propagation Environment Feb. 1992 6 p (For primary document see N92-22790 13-46)
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N92-22831# Italian Meteorological Service, Rome.
METEOROLOGY: INTRODUCTION
B. Bizzarri *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 40-46 (For primary document see N92-22826 13-42)
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N92-22837# Meteorological Office, Bracknell (England).
PRECIPITATION AND THE WATER CYCLE
K. Browning *In* ESA, Report of the Earth Observation User

Consultation Meeting Oct. 1991 p 94-99 (For primary document see N92-22826 13-42)
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N92-22838# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Lab. de Meteorologie Dynamique.
RADIATION AND THE ENERGY BALANCE: THE ROLE OF RADIATION
R. Kandel *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 100-114 (For primary document see N92-22826 13-42)
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N92-22854# Paris VI Univ. (France).
CONTRIBUTIONS TO CLIMATE RESEARCH: STUDY OF THE SOLID EARTH IS OF IMPORTANCE TO CLIMATE RESEARCH IN THREE AREAS
J.-F. Minster *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 240-241 (For primary document see N92-22826 13-42)
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N92-22855# Italian Meteorological Service, Rome.
METEOROLOGY: INTRODUCTION
B. Bizzarri *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 245-247 Original contains color illustrations (For primary document see N92-22826 13-42)
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N92-22856# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
OPERATIONAL METEOROLOGY: GENERAL OVERVIEW
J. Morgan *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 248-255 (For primary document see N92-22826 13-42)
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N92-22857# GKSS-Forschungszentrum Geesthacht (Germany, F.R.).
RADIATION AND CLOUDS
E. Raschke *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 256-259 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22858# Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
CONVECTION AND PRECIPITATION: MOISTURE CONVECTION AND METEOROLOGY
J. Testud *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 260-263 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22859# Meteorological Office, Bracknell (England).
SURFACE/ATMOSPHERE INTERACTIONS: INTRODUCTION
P. Mason *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 264-269 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22860# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
IMPROVED OBSERVATIONAL REQUIREMENTS FOR MODELLING: IMPROVEMENT OF NUMERICAL WEATHER PREDICTION
L. Bengtsson *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 270-273 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

N92-22862# European Organization for the Exploitation of Meteorological Satellites, Darmstadt (Germany, F.R.).
ANNEX B: LONG-TERM DEVELOPMENTS FOR OPERATIONAL METEOROLOGY
J. Morgan *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 280-282 (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-22839# Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
AIR-SEA INTERACTION
K. Hasselmann *In* ESA, Report of the Earth Observation User Consultation Meeting Oct. 1991 p 115-118 Original contains color illustrations (For primary document see N92-22826 13-42)
Copyright Avail: NTIS HC/MF A13; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 75 Dutch guilders

51 LIFE SCIENCES (GENERAL)

N92-22263 Cornell Univ., Ithaca, NY.
EXTRATERRESTRIAL ORGANIC MOLECULES, THE HEAVY BOMBARDMENT, AND THE TERRESTRIAL ORIGINS OF LIFE Ph.D. Thesis
Christopher Frank Chyba 1991 275 p
Avail: Univ. Microfilms Order No. DA9203903

The origins of life on Earth coincided with the end of the heavy bombardment of the inner Solar System. Sufficiently large and fast impacts during this bombardment would have eroded planetary atmospheres. The very largest impacts could have led to an 'impact frustration' of the origins of life. Simultaneously, volatile rich impactors delivered elements essential for life to planetary surfaces. Moreover, comets and carbonaceous asteroids are known to be rich in organic molecules, and may therefore have contributed directly to planetary prebiotic organic inventories. The lunar cratering record is used to constrain the importance of each of these effects for the early Earth. Uncertainties in fitting the lunar data are explicitly addressed, and resulting ambiguities in previous work is studied. The pyrolysis of exogenous organics within comets and asteroids traversing the terrestrial atmosphere and impacting Earth's surface is modeled in detail. The 3.4 micron infrared feature observed in comet Halley is modeled as thermal emission from submicron organic grains in the cometary coma. Good agreement with spacecraft determined optical depths is obtained, and specific predictions about the heliocentric evolution of cometary infrared spectra are made. Dissert. Abstr.

N92-22287# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
13 Feb. 1992 45 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-92-006) Avail: NTIS HC/MF A03

A bibliography is given of science and technology research in Central Eurasian countries. Topics covered include biochemistry,

biophysics, epidemiology, genetics, immunology, clinical medicine, microbiology, pharmacology, toxicology, physiology, public health, radiation biology, and virology. Author

N92-22288# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
11 Feb. 1992 98 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-92-005) Avail: NTIS HC/MF A05
A bibliography is given of science and technology research research in Central Eurasian countries in science and technology. Topics covered include agricultural science, biochemistry, environment, epidemiology, genetics, medicine, pharmacology, toxicology, physiology, public health, psychology, radiation biology, and veterinary medicine. Author

N92-22306# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
28 Feb. 1992 34 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-92-008) Avail: NTIS HC/MF A03
A bibliography is given of Central Eurasian research in life sciences. Topics covered include agriculture, biotechnology, immunology, laser treatment of cancer patients, microbiology, radiation effects, physiology, public health, radiation biology, and veterinary biology. Author

N92-22307# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
23 Dec. 1991 66 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-91-025) Avail: NTIS HC/MF A04
A bibliography of USSR research in life sciences is given. Topics covered include biophysics, epidemiology, immunology, laser bioeffects, medicine, microbiology, physiology, public health, and radiation biology. Author

N92-22308# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
14 Jan. 1992 82 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-92-002) Avail: NTIS HC/MF A05
A bibliography is given of Central Eurasian research in life sciences. Topics covered include medicine, microbiology, pharmacology, toxicology, physiology, public health, radiation biology, veterinary medicine, and virology. Author

N92-22309# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
28 Jan. 1992 55 p Transl. into ENGLISH of various Russian articles
(JPRS-ULS-92-003) Avail: NTIS HC/MF A04
A bibliography is given of Central Eurasian research in life sciences. Topics covered include aerospace medicine, agriculture, biotechnology, epidemiology, laser effects, military medicine, toxicology, physiology, public health, psychology, and virology. Author

N92-22311# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
30 Jan. 1992 33 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-92-004) Avail: NTIS HC/MF A03
A bibliography of Central Eurasian research in life sciences is given. Topics covered include agriculture, biochemistry, epidemiology, immunology, physiology, public health, and virology. Author

N92-22391# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: LIFE SCIENCES
9 Mar. 1992 34 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-92-009) Avail: NTIS HC/MF A03
A bibliography is given of Central Eurasian research in the life sciences. Topics covered include aerospace medicine, agriculture, biotechnology, epidemiology, genetics, laser bioeffects, microbiology, pharmacology, physiology, public health, and radiation biology. Author

N92-22393# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
3 Jan. 1992 31 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-92-001) Avail: NTIS HC/MF A03
A bibliography is given of U.S.S.R. research in life sciences. Topics covered include agriculture, biochemistry, biotechnology, epidemiology, genetics, immunology, industrial medicine, and laser biophysics. Author

N92-22430*# Northeastern Forest Experiment Station, Delaware, OH. Forestry Sciences Lab.
ENHANCEMENT OF BIOLOGICAL CONTROL AGENTS FOR USE AGAINST FOREST INSECT PESTS AND DISEASES THROUGH BIOTECHNOLOGY
James M. Slavicek *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 51-58 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06C

N92-22431*# Brookhaven National Lab., Upton, NY. Biology Dept.
USE OF T7 RNA POLYMERASE TO DIRECT EXPRESSION OF OUTER SURFACE PROTEIN A (OspA) FROM THE LYME DISEASE SPIROCHETE, BORRELIA BURGDORFERI
John J. Dunn and Barbara N. Lade *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 59-64 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06C

N92-22700*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE ROTATING SPECTROMETER: BIOTECHNOLOGY FOR CELL SEPARATIONS
David A. Noever *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 202-211 Previously announced as N91-15673 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06C

N92-22729*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STRUCTURAL MODIFICATION OF POLYSACCHARIDES: A BIOCHEMICAL-GENETIC APPROACH
Roger G. Kern and Gene R. Petersen *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 480-485 Sponsored in part by Defense Advanced Research Projects Agency (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06C

N92-23066# Academic Center for Dentistry, Amsterdam (Netherlands) Dept. of Oral Cell Biology.
EFFECT OF MICROGRAVITY AND MECHANICAL STIMULATION ON THE IN VITRO MINERALIZATION AND RESORPTION OF FETAL MOUSE LONG BONES
J. P. Veldhuijzen and J. J. W. A. vanLoon *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 112-113 Repr. from

Proceedings of the 4th International Conference on the WEGENER/MEDLAS project, Scheveningen, Netherlands, 7-9 Jun. 1989, Feb. 1990 p 281-300 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23067# Hubrecht Lab., Utrecht (Netherlands).
ROLE OF GRAVITY IN THE ESTABLISHMENT OF THE DORSO-VENTRAL AXIS IN THE AMPHIBIAN EMBRYO
G. A. Ubbels, S. C. J. Kerkvliet, and J. M. Narraway *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 114-117 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23068# Utrecht State Univ. (Netherlands). Dept. of Molecular Cell Biology.
REGULATION OF CELL GROWTH AND DIFFERENTIATION BY MICROGRAVITY
P. J. Rijken, R. P. deGroot, J. Boonstra, W. Kruijer, A. J. Verkleij, and S. W. deLaat (Hubrecht Lab., Utrecht, Netherlands) *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 118-120 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23069# Amsterdam Univ. (Netherlands). Dept. of Molecular Cell Biology.
EFFECTS OF MICROGRAVITY ON THE PLASMA MEMBRANE-CYTOSKELETON INTERACTIONS DURING CELL DIVISION IN CHLAMYDOMONAS Abstract Only
H. vandenEnde *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 121 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23070# Amsterdam Univ. (Netherlands). Dept. of Molecular Cell Biology.
BACTERIAL PROLIFERATION UNDER MICROGRAVITY CONDITIONS
C. L. Woldringh and M. A. J. M. vanBakel *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 122-124 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23072# Amsterdam Univ. (Netherlands). Dept. of Otorhinolaryngology.
THE EFFECT OF MICROGRAVITY ON (1) PUPIL SIZE, (2) VESTIBULAR CALORIC NYSTAGMUS AND (3) THE SWIMMING BEHAVIOUR OF FISH
W. J. Oosterveld, H. A. A. deJong, and H. W. Kortschot *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 129-131 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-22127# Food and Drug Administration, Rockville, MD. Center for Devices and Radiological Health.
CLASSIFICATION NAMES FOR MEDICAL DEVICES AND IN VITRO DIAGNOSTIC PRODUCTS
Aug. 1991 270 p
(PB92-111640; FDA/CDRH-91/35; DHHS/Pub/FDA-91-4246)
Avail: NTIS HC/MF A12 CSCL 06P

The directory contains product names developed by the Food and Drug Administration (FDA) device classification panels and additional names established by the FDA to support premarket notification and other processes. The directory updates and combines two separate editions of product code directories published in 1977. The product codes contained in the directory are to be used in any submissions to the FDA which require a product code. Each product name is identified by a product code which consists of five digits. The directory also contains the regulation citation to Title 21, Code of Federal Regulations, and the class of the device. The directory is organized by keywords in alphabetical order. Author

N92-22186*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MULTIPLE LESION TRACK STRUCTURE MODEL
John W. Wilson, Francis A. Cucinotta, and Judy L. Shinn Mar. 1992 14 p Sponsored in part by the Armed Forces Radiobiology Research Institute
(NASA-TP-3185; L-16988; NAS 1.60:3185) Avail: NTIS HC/MF A03 CSCL 06P

A multilesion cell kinetic model is derived, and radiation kinetic coefficients are related to the Katz track structure model. The repair-related coefficients are determined from the delayed plating experiments of Yang et al. for the C3H10T1/2 cell system. The model agrees well with the x ray and heavy ion experiments of Yang et al. for the immediate plating, delaying plating, and fractionated exposure protocols employed by Yang. A study is made of the effects of target fragments in energetic proton exposures and of the repair-deficient target-fragment-induced lesions. Author

N92-22332*# Aerospace Medical Research Labs., Brooks AFB, TX. Sustained Operations Branch.
THE NEUROCHEMICAL BASIS OF PHOTIC ENTRAINMENT OF THE CIRCADIAN PACEMAKER
Michael A. Rea, Becky Buckley, and Lewis M. Lutton (Mercyhurst Coll., Erie, PA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 476-481 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22333*# Aerospace Medical Research Labs., Brooks AFB, TX.
PHOTIC EFFECTS ON SUSTAINED PERFORMANCE
J. French, J. Whitmore, P. J. Hannon, G. Brainard (Jefferson Medical Coll., Philadelphia, PA.), and S. Schiflett *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 482-486 Sponsored by NASA; AF; and DoD (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22338*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE APPLICATION OF INTEGRATED KNOWLEDGE-BASED SYSTEMS FOR THE BIOMEDICAL RISK ASSESSMENT INTELLIGENT NETWORK (BRAIN)
Karin C. Loftin, Bebe Ly, Laurie Webster, James Verlander (Krug Life Sciences, Inc., Houston, TX.), Gerald R. Taylor, Gary Riley, and Chris Culbert *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 522-528 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22350*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE SICKNESS PREDICTORS SUGGEST FLUID SHIFT INVOLVEMENT AND POSSIBLE COUNTERMEASURES
K. E. Simanonok, E. C. Moseley, and J. B. Charles *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 595-604 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22351*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMPUTER SIMULATION OF PREFLIGHT BLOOD VOLUME REDUCTION AS A COUNTERMEASURE TO FLUID SHIFTS IN SPACE FLIGHT
K. E. Simanonok, R. Srinivasan, and J. B. Charles *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 605-608 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22352*# Aerospace Medical Research Labs., Brooks AFB, TX. High Altitude Protection Function.
THE 1990 HYPOBARIC DECOMPRESSION SICKNESS WORKSHOP: SUMMARY AND CONCLUSIONS Abstract Only
Andrew A. Pilmanis, Barbara J. Stegmann (Krug Life Sciences, Inc., San Antonio, TX.), and Terrell E. Scoggins *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 609 Presented at the AGARD 71st Aerospace Medical Panel Symposium, 29 Apr. - 3 May 1991, Pensacola, FL Submitted for publication (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22353*# Krug Life Sciences, Inc., San Antonio, TX.
IMPROVING SURVIVAL AFTER TISSUE VAPORIZATION (EBULLISM) Abstract Only
Barbara J. Stegmann, Andrew A. Pilmanis, and Toniann Derion (Aerospace Medical Research Labs., Brooks AFB, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 610 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22355*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HUMAN EXPOSURE LIMITS TO HYPERGOLIC FUELS
H. D. Garcia, J. T. James, and T. F. Limero (Krug Life Sciences, Inc., Houston, TX.) *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 620-626 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22356*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HYDRAZINE MONITORING IN SPACECRAFT
J. H. Cross, S. W. Beck, T. F. Limero (Krug Life Sciences, Inc., Houston, TX.), and J. T. James *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 627-636 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22357*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Toxic Hazards Div.
COMPARISON OF DERMAL AND INHALATION ROUTES OF ENTRY FOR ORGANIC CHEMICALS
Gary W. Jepson, James N. McDougal, and Harvey J. Clewell, III *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 637-638 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22358*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
OCCUPATIONAL SAFETY CONSIDERATIONS WITH HYDRAZINE Abstract Only
Harvey J. Clewell, III, James N. McDougal, Marilyn E. George, and Melvin E. Andersen *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 639 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

N92-22428*# National Cancer Inst., Bethesda, MD. Office of Technology Development.
COOPERATIVE RESEARCH AND DEVELOPMENT OPPORTUNITIES WITH THE NATIONAL CANCER INSTITUTE
Kathleen Sybert *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 39-46 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06P

N92-22429*# Centers for Disease Control, Atlanta, GA. Technology Transfer Office.
TECHNOLOGIES FOR THE MARKETPLACE FROM THE CENTERS FOR DISEASE CONTROL
Frances L. Reid-Sanden, R. Eric Greene, and Dolores M. Malvitz *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 47-50 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06P

N92-22464*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPUTATION OF INCOMPRESSIBLE VISCOUS FLOWS THROUGH ARTIFICIAL HEART DEVICES WITH MOVING BOUNDARIES
Cetin Kiris, Stuart Rogers, Dochan Kwak, and I.-Dee Chang (Stanford Univ., CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 351-358 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06A

N92-22699*# Agricultural Research Service, Ames, IA. National Soil Tilth Lab.
NUCLEIC ACID PROBES IN DIAGNOSTIC MEDICINE
Phillip A. OBerry *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 197-201 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06B

N92-22733*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACOUSTICALLY BASED FETAL HEART RATE MONITOR
Donald A. Baker (Baker Guardian Medical Labs., Spokane, WA.) and Allan J. Zuckerwar *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 512-517 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06B

N92-22734*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SURGICAL FORCE DETECTION PROBE
Ping Tcheng, Paul Roberts, Charles Scott, and Richard Prass (Eastern Virginia Medical School,. Norfolk.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 518-532 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06B

N92-23071# Amsterdam Univ. (Netherlands). Dept. of Physiology.
CONTROL OF BLOOD PRESSURE IN HUMANS UNDER MICROGRAVITY
J. M. Karemaker, E. M. Akkerman, M. vanLeeuwen, K. H. Wesseling, J. J. Settels, W. Wieling (Academic Medical Center, Amsterdam, Netherlands), and J. H. A. Dambrink *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 125-128 (For primary

document see N92-23064 13-29)
Avail: NTIS HC/MF A10

N92-23073# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
OTOLITH RESPONSES IN MAN DURING PARABOLIC FLIGHT
J. T. Marcus *In* Space Research Organization Netherlands, Activities Report of the Space Research Organization Netherlands Apr. 1991 p 131-133 (For primary document see N92-23064 13-29)
Avail: NTIS HC/MF A10

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N92-22670# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Industrial Psychology.
MENTAL WORKLOAD: RESEARCH ON COMPUTER-AIDED DESIGN WORK AND ON THE IMPLEMENTATION OF OFFICE AUTOMATION Ph.D. Thesis
Eila Jaervenpaeae 1991 294 p Sponsored by Academy of Finland; Aaltonen Foundation; and Anna S. Elonen Foundation (Rept-130/1991/Tps; ISBN-951-22-0572-6; ISSN-0784-3623; PB92-127372; ETN-92-91174) Avail: NTIS HC/MF A13

A study to test and develop research methods on mental workload and to study mental workload in jobs which involve the use of information technology, with focus on short term mental strain, is presented. Theoretical and research approaches and previous finding are considered. Mental workload among CAD (Computer Aided Design) designers was studied by means of a cross sectional design. The effects of the implementation of office automation on mental workload among distinct court personnel are studied longitudinally. In rather low demanding work, job demands were positively connected with positive short term mental strain. When job demands were in the intermediate level autonomy also became important with regard to positive short term mental strain. In highly demanding jobs, feedback from the job itself became an important job characteristic that was partly independent of job demands in affecting positive short term mental strain in all jobs studied. However, feedback from other people seemed to be slightly more important in less demanding jobs. ESA

N92-22331*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Optical Systems Branch.
EFFECT OF MICROGRAVITY ON SEVERAL VISUAL FUNCTIONS DURING STS SHUTTLE MISSIONS
Melvin R. ONeal, H. Lee Task, and Louis V. Genco *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 468-475 Previously announced in IAA as A91-14170 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22334*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
THE EFFECTS OF MULTIPLE AEROSPACE ENVIRONMENTAL STRESSORS ON HUMAN PERFORMANCE
S. E. Popper, D. W. Repperger, K. McCloskey, and L. D. Tripp (Systems Research Labs., Inc., Dayton, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 487-495 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22335*# Aerospace Medical Research Labs., Brooks AFB, TX. Sustained Operations Branch.
MICROGRAVITY EFFECTS ON STANDARDIZED COGNITIVE PERFORMANCE MEASURES
Samuel G. Schiflett *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 496-505 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22341*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
SITUATION AWARENESS IN COMMAND AND CONTROL SETTINGS Abstract Only
Robert W. Patterson *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 544 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22342*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
EVALUATING HUMAN PERFORMANCE MODELING FOR SYSTEM ASSESSMENT: PROMISE AND PROBLEMS
Robert W. Patterson and Michael J. Young *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 545 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22347*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANGULAR RELATION OF AXES IN PERCEPTUAL SPACE
Urs Bucher *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 575-581 Prepared in cooperation with Zurich Univ. (Switzerland) (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22349*# Krug Life Sciences, Inc., San Antonio, TX.
TRACKING PERFORMANCE WITH TWO BREATHING OXYGEN CONCENTRATIONS AFTER HIGH ALTITUDE RAPID DECOMPRESSION
Thomas E. Nesthus, Samuel G. Schiflett, and Carolyn J. Oakley (Aerospace Medical Research Labs., Brooks AFB, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 590-594 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

N92-22466*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXTENDED ATTENTION SPAN TRAINING SYSTEM
Alan T. Pope and Edward H. Bogart (Lockheed Engineering and Sciences Co., Hampton, VA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 368-374 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-22283*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MICROBIAL BIOFILM STUDIES OF THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM WATER RECOVERY TEST FOR SPACE STATION FREEDOM
E. B. Rodgers, D. C. Obenhuber, and T. L. Huff (Sverdrup Technology, Inc., Huntsville, AL.) Apr. 1992 13 p
(NASA-TM-103579; NAS 1.15:103579) Avail: NTIS HC/MF A03 CSCL 06K

NASA is developing a water recovery system (WRS) for Space Station Freedom to reclaim human waste water for reuse by astronauts as hygiene or potable water. A water recovery test (WRT) currently in progress investigates the performance of a prototype of the WRS. Analysis of biofilm accumulation, the potential for microbially influenced corrosion (MIC) in the WRT, and studies of iodine disinfection of biofilm are reported. Analysis of WRT components indicated the presence of organic deposits and biofilms in selected tubing. Water samples for the WRT contained acid-producing and sulfate-reducing organisms implicated in corrosion processes. Corrosion of an aluminum alloy was accelerated in the presence of these water samples; however, stainless steel corrosion rates were not accelerated. Biofilm iodine sensitivity tests using an experimental laboratory scale recycled water system containing a microbial check valve (MCV) demonstrated that an iodine concentration of 1 to 2 mg/L was ineffective in eliminating microbial biofilm. For complete disinfection, an initial concentration of 16 mg/L was required, which was gradually reduced by the MCV over 4 to 8 hours to 1 to 2 mg/L. This treatment may be useful in controlling biofilm formation.
Author

N92-22290# Little (Arthur D.), Inc., Cambridge, MA.
IMPROVEMENT OF PMN REVIEW PROCEDURES TO ESTIMATE PROTECTIVE CLOTHING PERFORMANCE: EXECUTIVE SUMMARY REPORT Final Report, Sep. 1989 - Sep. 1990
R. Goydan, A. D. Schwope, T. R. Carroll, and T. J. Stolki Dec. 1991 45 p
(Contract EPA-68-C9-0037)
(PB92-105691; ADL-64320-10; EPA/600/2-91/059) Avail: NTIS HC/MF A03 CSCL 05H

In a five-year program performed with the EPA Office of Research and Development, the Chemical Engineering Branch (CEB) of the EPA Office of Toxic Substances has developed state-of-the-art tools for assessing the effectiveness of rubber and plastic protective clothing materials as barriers to chemicals. These tools were developed for use by CEB to conduct more thorough assessments of the potential for occupational exposures to new chemicals as required in the Premanufacture Notification (PMN) review process. The tools include: a computerized model for predicting the permeation of chemicals through common clothing materials using Fickian diffusion theory and the physical property data typically available from a PMN submission; guidelines for specifying permeation testing and interpreting the results of such tests, including development of a new, intermittent chemical contact permeation test method; and a manual that guides the assessment of protective clothing permeation on the basis of published data, data from CEB-prescribed testing and the output of the predictive model. The report describes the development of these tools and lists the products delivered under the project from Oct. 1985 through Sep. 1990. By applying these tools, CEB can perform more thorough and efficient PMN reviews and identify other areas that require improvement in their assessments of chemical protective clothing performance.
GRA

N92-22325*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NASA HUMAN FACTORS PROGRAMMATIC OVERVIEW
Mary M. Connors *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 434-437 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22326*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF AN EMPIRICALLY BASED DYNAMIC BIOMECHANICAL STRENGTH MODEL
A. Pandya, J. Maida, A. Aldridge, S. Hasson (Texas Woman's Univ., Houston.), and B. Woolford *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 438-444 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22327*# NTI, Inc., San Antonio, TX.
PERFORMANCE ASSESSMENT IN COMPLEX INDIVIDUAL AND TEAM TASKS
Douglas R. Eddy *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 445-450 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22330*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MEASUREMENT OF PERFORMANCE USING ACCELERATION CONTROL AND PULSE CONTROL IN SIMULATED SPACECRAFT DOCKING OPERATIONS
Adam R. Brody (Sterling Software, Moffett Field, CA.) and Stephen R. Ellis *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 460-466 Presented at the Aerospace Sciences Meeting, Reno, NV, Jan. 1991; sponsored in part by AIAA Previously announced in IAA as A91-19464 (For primary document see N92-22324 13-59)
(AIAA-91-0787) Avail: NTIS HC/MF A17 CSCL 05H

N92-22339*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DESIGN FOR INTERACTION BETWEEN HUMANS AND INTELLIGENT SYSTEMS DURING REAL-TIME FAULT MANAGEMENT
Jane T. Malin, Debra L. Schreckenghost, and Carroll G. Thronesbery (Mitre Corp., Houston, TX.) *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 530-538 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22340*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A HUMAN FACTORS EVALUATION OF THE ROBOTIC INTERFACE FOR SPACE STATION FREEDOM ORBITAL REPLACEABLE UNITS
Carlos E. Sampaio, Ellen Y. Hwang, Terence F. Fleming, Mark A. Stuart (Lockheed Engineering and Sciences Co., Houston, TX.), and A. Jay Legendre *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 539-543 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22344*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
VISUALLY COUPLED SYSTEMS (VCS): THE VIRTUAL PANORAMIC DISPLAY (VPD) SYSTEM
Dean F. Kocian *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 548-561 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22345*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
THE EVALUATION OF PARTIAL BINOCULAR OVERLAP ON CAR MANEUVERABILITY: A PILOT STUDY
Brian H. Tsou, Beth M. Rogers-Adams, and Charles D. Goodyear (Logicon Technical Services, Inc., Dayton, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 562-568 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22346*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THREE DIMENSIONAL TRACKING WITH MISALIGNMENT BETWEEN DISPLAY AND CONTROL AXES
Stephen R. Ellis, Mitchell Tyler, Won S. Kim, and Lawrence Stark (California Univ., Berkeley.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 569-574 (For primary document see N92-22324 13-59)
(Contract NCC2-86)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22348*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AN INTELLIGENT CONTROL AND VIRTUAL DISPLAY SYSTEM FOR EVOLUTIONARY SPACE STATION WORKSTATION DESIGN
Xin Feng, Russell J. Niederjohn (Marquette Univ., Milwaukee, WI.), and Michael W. McGreevy *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 582-587 (For primary document see N92-22324 13-59)
(Contract NCC2-681)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22354*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TOXICOLOGICAL APPROACH TO SETTING SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS FOR CARBON MONOXIDE
K. L. Wong, T. F. Limero (Krug Life Sciences, Inc., Houston, TX.), and J. T. James *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 612-619 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

N92-22465*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COMPUTER INTERFACES FOR THE VISUALLY IMPAIRED
Gerry Higgins *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 359-367 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05H

N92-22467*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MAN/MACHINE INTERACTION DYNAMICS AND PERFORMANCE (MMIDAP) CAPABILITY
Harold P. Frisch *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 375-382 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05H

N92-22480*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
APPLICATIONS OF CELSS TECHNOLOGY TO CONTROLLED ENVIRONMENT AGRICULTURE
Maynard E. Bates (Bionetics Corp., Moffett Field, CA.) and David L. Bubenheim *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 497-506 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06K

N92-22483*# School of Aerospace Medicine, Brooks AFB, TX. Crew Technology Div.
A 99 PERCENT PURITY MOLECULAR SIEVE OXYGEN GENERATOR
G. W. Miller *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 523-535 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06K

N92-22735*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DYNAMIC INTER-LIMB RESISTANCE EXERCISE DEVICE FOR LONG-DURATION SPACE FLIGHT
Douglas F. Schwandt, Donald E. Watenpaugh, Scott E. Parazynski, and Alan R. Hargens *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 533-537 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N92-22324*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FIFTH ANNUAL WORKSHOP ON SPACE OPERATIONS APPLICATIONS AND RESEARCH (SOAR 1991), VOLUME 2
Kumar Krishen, ed. Feb. 1992 391 p Workshop held in Houston, TX, 9-11 Jul. 1991; sponsored in cooperation with NASA, Washington, AF, and Houston Univ., Clear Lake, TX
(NASA-CP-3127-Vol-2; S-650-Vol-2; NAS 1.55:3127-Vol-2) Avail: NTIS HC/MF A17 CSCL 06K

Papers given at the Space Operations and Applications Symposium, host by the NASA Johnson Space Center on July 9-11, 1991 are given. The technical areas covered included intelligent systems, automation and robotics, human factors and life sciences, and environmental interactions. For individual titles, see N92-22325 through N92-22384.

N92-22325*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NASA HUMAN FACTORS PROGRAMMATIC OVERVIEW **c54**
Mary M. Connors *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 434-437 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

Human factors addresses humans in their active and interactive capacities, i.e., in the mental and physical activities that they perform and in the contributions they make to achieving the goals of the mission. The overall goal of space human factors in NASA is to support the safety, productivity, and reliability of both the on-board crew and the ground support staff. Safety and reliability are fundamental requirements that human factors shares with other disciplines, while productivity represents the defining contribution of the human factors discipline. Author

N92-22326*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DEVELOPMENT OF AN EMPIRICALLY BASED DYNAMIC BIOMECHANICAL STRENGTH MODEL **c54**
A. Pandya, J. Maida, A. Aldridge, S. Hasson (Texas Woman's Univ., Houston.), and B. Woolford *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 438-444 (For primary document see

N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

The focus here is on the development of a dynamic strength model for humans. Our model is based on empirical data. The shoulder, elbow, and wrist joints are characterized in terms of maximum isolated torque, position, and velocity in all rotational planes. This information is reduced by a least squares regression technique into a table of single variable second degree polynomial equations determining the torque as a function of position and velocity. The isolated joint torque equations are then used to compute forces resulting from a composite motion, which in this case is a ratchet wrench push and pull operation. What is presented here is a comparison of the computed or predicted results of the model with the actual measured values for the composite motion.
Author

N92-22327*# NTI, Inc., San Antonio, TX.
PERFORMANCE ASSESSMENT IN COMPLEX INDIVIDUAL AND TEAM TASKS **c54**
Douglas R. Eddy *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 445-450 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

Described here is an eclectic, performance based approach to assessing cognitive performance from multiple perspectives. The experience gained from assessing the effects of antihistamines and scenario difficulty on C (exp 2) decision making performance in Airborne Warning and Control Systems (AWACS) weapons director (WD) teams can serve as a model for realistic simulations in space operations. Emphasis is placed on the flexibility of measurement, hierarchical organization of measurement levels, data collection from multiple perspectives, and the difficulty of managing large amounts of data.
Author

N92-22328*# Systems Research Labs., Inc., San Antonio, TX.
STRUCTURED ANALYSIS AND MODELING OF COMPLEX SYSTEMS **c61**
David R. Strome and Mathieu A. Dalrymple *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 451-453 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09B

The Aircrew Evaluation Sustained Operations Performance (AESOP) facility at Brooks AFB, Texas, combines the realism of an operational environment with the control of a research laboratory. In recent studies we collected extensive data from the Airborne Warning and Control Systems (AWACS) Weapons Directors subjected to high and low workload Defensive Counter Air Scenarios. A critical and complex task in this environment involves committing a friendly fighter against a hostile fighter. Structured Analysis and Design techniques and computer modeling systems were applied to this task as tools for analyzing subject performance and workload. This technology is being transferred to the Man-Systems Division of NASA Johnson Space Center for application to complex mission related tasks, such as manipulating the Shuttle grappler arm.
Author

N92-22329*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EVALUATION OF FORCE-TORQUE DISPLAYS FOR USE WITH SPACE STATION TELEROBOTIC ACTIVITIES **c37**
Robert C. Hendrich, John M. Bierschwale, Meera K. Manahan, Mark A. Stuart (Lockheed Engineering and Sciences Co., Houston, TX.), and A. Jay Legendre *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 454-459 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 13I

Recent experiments which addressed Space Station remote manipulation tasks found that tactile force feedback (reflecting forces and torques encountered at the end-effector through the manipulator hand controller) does not improve performance significantly. Subjective response from astronaut and non-astronaut test subjects indicated that force information, provided visually, could be useful. No research exists which specifically investigates methods of presenting force-torque information visually. This experiment was designed to evaluate seven different visual force-torque displays which were found in an informal telephone survey. The displays were prototyped in the HyperCard programming environment. In a within-subjects experiment, 14 subjects nullified forces and torques presented statically, using response buttons located at the bottom of the screen. Dependent measures included questionnaire data, errors, and response time. Subjective data generally demonstrate that subjects rated variations of pseudo-perspective displays consistently better than bar graph and digital displays. Subjects commented that the bar graph and digital displays could be used, but were not compatible with using hand controllers. Quantitative data show similar trends to the subjective data, except that the bar graph and digital displays both provided good performance, perhaps do to the mapping of response buttons to display elements. Results indicate that for this set of displays, the pseudo-perspective displays generally represent a more intuitive format for presenting force-torque information.
Author

N92-22330*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
MEASUREMENT OF PERFORMANCE USING ACCELERATION CONTROL AND PULSE CONTROL IN SIMULATED SPACECRAFT DOCKING OPERATIONS **c54**
Adam R. Brody (Sterling Software, Moffett Field, CA.) and Stephen R. Ellis *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 460-466 Presented at the Aerospace Sciences Meeting, Reno, NV, Jan. 1991; sponsored in part by AIAA Previously announced in IAA as A91-19464 (For primary document see N92-22324 13-59)
(AIAA-91-0787) Avail: NTIS HC/MF A17 CSCL 05H

Nine commercial airline pilots served as test subjects in a study to compare acceleration control with pulse control in simulated spacecraft maneuvers. Simulated remote dockings of an orbital maneuvering vehicle (OMV) to a space station were initiated from 50, 100, and 150 meters along the station's -V-bar (minus velocity vector). All unsuccessful missions were reflown. Five way mixed analysis of variance (ANOVA) with one between factor, first mode, and four within factors (mode, bloch, range, and trial) were performed on the data. Recorded performance measures included mission duration and fuel consumption along each of the three coordinate axes. Mission duration was lower with pulse mode, while delta V (fuel consumption) was lower with acceleration mode. Subjects used more fuel to travel faster with pulse mode than with acceleration mode. Mission duration, delta V, X delta V, Y delta V, and Z delta V all increased with range. Subjects commanded the OMV to 'fly' at faster rates from further distances. These higher average velocities were paid for with increased fuel consumption. Asymmetrical transfer was found in that the mode transitions could not be predicted solely from the mission duration main effect. More testing is advised to understand the manual control aspects of spaceflight maneuvers better.
Author

N92-22331*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Optical Systems Branch.
EFFECT OF MICROGRAVITY ON SEVERAL VISUAL FUNCTIONS DURING STS SHUTTLE MISSIONS **c53**
Melvin R. ONeal, H. Lee Task, and Louis V. Genco *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 468-475 Previously announced in IAA as A91-14170 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

Changes in the acuity of astronaut vision during flight are discussed. Parameters such as critical flicker vision, stereopsis to 10 seconds of arc, visual acuity in small steps to 20/7.7, cyclophoria, lateral and vertical phoria and retinal rivalry were tested

using a visual function tester. Twenty-three Space Transportation System (STS) astronauts participated in the experiments. Their vision was assessed twice before launch and after landing, and three to four times while on-orbit and landing. No significant differences during space flight were observed for any of the visual parameters tested. In some cases, slight changes in acuity and stereopsis were observed with a subsequent return to normal vision after flight. Author

N92-22332*# Aerospace Medical Research Labs., Brooks AFB, TX. Sustained Operations Branch.

THE NEUROCHEMICAL BASIS OF PHOTIC ENTRAINMENT OF THE CIRCADIAN PACEMAKER c52

Michael A. Rea, Becky Buckley, and Lewis M. Lutton (Mercyhurst Coll., Erie, PA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 476-481 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 06P

Circadian rhythmicity in mammals is controlled by the action of a light-entrainable hypothalamus, in association with two cell clusters known as the supra chiasmatic nuclei (SCN). In the absence of temporal environmental clues, this pacemaker continues to measure time by an endogenous mechanism (clock), driving biochemical, physiological, and behavioral rhythms that reflect the natural period of the pacemaker oscillation. This endogenous period usually differs slightly from 24 hours (i.e., circadian). When mammals are maintained under a 24 hour light-dark (LD) cycle, the pacemaker becomes entrained such that the period of the pacemaker oscillation matches that of the LD cycle. Potentially entraining photic information is conveyed to the SCN via a direct retinal projection, the retinohypothalamic tract (RHT). RHT neurotransmission is thought to be mediated by the release of excitatory amino acids (EAA) in the SCN. In support of this hypothesis, recent experiments using nocturnal rodents have shown that EAA antagonists block the effects of light on pacemaker-driven behavioral rhythms, and attenuate light induced gene expression in SCN cells. An understanding of the neurochemical basis of the photic entrainment process would facilitate the development of pharmacological strategies for maintaining synchrony among shift workers in environments, such as the Space Station, which provide unreliable or conflicting temporal photic clues. Author

N92-22333*# Aerospace Medical Research Labs., Brooks AFB, TX.

PHOTIC EFFECTS ON SUSTAINED PERFORMANCE c52

J. French, J. Whitmore, P. J. Hannon, G. Brainard (Jefferson Medical Coll., Philadelphia, PA.), and S. Schiflett *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 482-486 Sponsored by NASA; AF; and DoD (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 06P

Research is described which evaluates manipulating environmental light intensity as a means to attenuate fatigue. A counter balanced, within-subjects design was used to compare nine male subjects exposed to dim (100 lux) and bright (3000 lux) light conditions. Oral temperature values were greater for the bright light group over the dim light condition. Melatonin levels were suppressed by bright light treatment. Also, the frequency of eye blink rate was less for subjects during bright over dim light exposure. Light exposure was without effect on subjective fatigue. However, irrespective of light condition, significant effects on confusion, fatigue, and vigor mood dimensions were found as a result of 30 hour sleep deprivation. The findings suggest that bright lights may be used to help sustain nocturnal activity otherwise susceptible to fatigue. Such findings may have implications for the lighting arrangements on space flights during the subjective night for astronauts. Author

N92-22334*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

THE EFFECTS OF MULTIPLE AEROSPACE ENVIRONMENTAL STRESSORS ON HUMAN PERFORMANCE c53

S. E. Popper, D. W. Repperger, K. McCloskey, and L. D. Tripp (Systems Research Labs., Inc., Dayton, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 487-495 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 05I

An extended Fitt's law paradigm reaction time (RT) task was used to evaluate the effects of acceleration on human performance in the Dynamic Environment Simulator (DES) at Armstrong Laboratory, Wright-Patterson AFB, Ohio. This effort was combined with an evaluation of the standard CSU-13 P anti-gravity suit versus three configurations of a 'retrograde inflation anti-G suit'. Results indicated that RT and error rates increased 17 percent and 14 percent respectively from baseline to the end of the simulated aerial combat maneuver and that the most common error was pressing too few buttons. Author

N92-22335*# Aerospace Medical Research Labs., Brooks AFB, TX. Sustained Operations Branch.

MICROGRAVITY EFFECTS ON STANDARDIZED COGNITIVE PERFORMANCE MEASURES c53

Samuel G. Schiflett *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 496-505 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 05I

The purpose of this experiment, selected to fly on the International Microgravity Laboratory (IML-2) Spacelab mission, is to determine the effects of microgravity upon the cognitive skills which are critical to successful performance of many tasks on board the Space Shuttle. Six tests from the Unified Tri-service Cognitive Performance Assessment Battery (UTC-PAB) will be administered to the Mission Specialists to fulfill the goals of this experiment. These tests are based upon current theoretical models of human performance and the hypothesized effects of microgravity. The principle objective is the identification of the effects of microgravity upon specific information processing skills affecting performance from those of fatigue and shifts in work/rest cycles. Multiple measures of both short and long term fatigue will be obtained and used as a major independent variable for the analysis of these performance data. Scientific supporting studies will determine optimum practice and performance testing schedules for the astronauts. The same tests will be used post-flight to collect data on the recovery of any cognitive performance impairment compared with pre-flight, baseline levels. Author

N92-22336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

TRANSPORTABLE APPLICATIONS ENVIRONMENT (TAE) PLUS: A NASA TOOL USED TO DEVELOP AND MANAGE GRAPHICAL USER INTERFACES c61

Martha R. Szczur *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 508-513 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 09B

The Transportable Applications Environment (TAE) Plus was built to support the construction of graphical user interfaces (GUI's) for highly interactive applications, such as real-time processing systems and scientific analysis systems. It is a general purpose portable tool that includes a 'What You See Is What You Get' WorkBench that allows user interface designers to layout and manipulate windows and interaction objects. The WorkBench includes both user entry objects (e.g., radio buttons, menus) and data-driven objects (e.g., dials, gages, stripcharts), which dynamically change based on values of realtime data. Discussed here is what TAE Plus provides, how the implementation has utilized state-of-the-art technologies within graphic workstations, and how it has been used both within and without NASA. Author

N92-22337*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.
COMPUTER AIDED SYSTEMS HUMAN ENGINEERING: A HYPERMEDIA TOOL **c61**
Kenneth R. Boff, Donald L. Monk, and William J. Cody (Search Technology, Inc., Atlanta, GA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 514-521 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09B

The Computer Aided Systems Human Engineering (CASHE) system, Version 1.0, is a multimedia ergonomics database on CD-ROM for the Apple Macintosh II computer, being developed for use by human system designers, educators, and researchers. It will initially be available on CD-ROM and will allow users to access ergonomics data and models stored electronically as text, graphics, and audio. The CASHE CD-ROM, Version 1.0 will contain the Boff and Lincoln (1988) Engineering Data Compendium, MIL-STD-1472D and a unique, interactive simulation capability, the Perception and Performance Prototyper. Its features also include a specialized data retrieval, scaling, and analysis capability and the state of the art in information retrieval, browsing, and navigation. Author

N92-22338*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
THE APPLICATION OF INTEGRATED KNOWLEDGE-BASED SYSTEMS FOR THE BIOMEDICAL RISK ASSESSMENT INTELLIGENT NETWORK (BRAIN) **c52**
Karin C. Loftin, Bebe Ly, Laurie Webster, James Verlander (Krug Life Sciences, Inc., Houston, TX.), Gerald R. Taylor, Gary Riley, and Chris Culbert *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 522-528 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

One of NASA's goals for long duration space flight is to maintain acceptable levels of crew health, safety, and performance. One way of meeting this goal is through BRAIN, an integrated network of both human and computer elements. BRAIN will function as an advisor to mission managers by assessing the risk of inflight biomedical problems and recommending appropriate countermeasures. Described here is a joint effort among various NASA elements to develop BRAIN and the Infectious Disease Risk Assessment (IDRA) prototype. The implementation of this effort addresses the technological aspects of knowledge acquisition, integration of IDRA components, the use of expert systems to automate the biomedical prediction process, development of a user friendly interface, and integration of IDRA and ExerCISys systems. Because C language, CLIPS and the X-Window System are portable and easily integrated, they were chosen ss the tools for the initial IDRA prototype. Author

N92-22339*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DESIGN FOR INTERACTION BETWEEN HUMANS AND INTELLIGENT SYSTEMS DURING REAL-TIME FAULT MANAGEMENT **c54**
Jane T. Malin, Debra L. Schreckenghost, and Carroll G. Thronesbery (Mitre Corp., Houston, TX.) *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 530-538 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

Initial results are reported to provide guidance and assistance for designers of intelligent systems and their human interfaces. The objective is to achieve more effective human-computer interaction (HCI) for real time fault management support systems. Studies of the development of intelligent fault management systems within NASA have resulted in a new perspective of the user. If the user is viewed as one of the subsystems in a heterogeneous, distributed system, system design becomes the design of a flexible architecture for accomplishing system tasks with both human and computer agents. HCI requirements and design should be distinguished from user interface (displays and controls) requirements and design. Effective HCI design for multi-agent systems requires explicit identification of activities and information that support coordination and communication between agents. The effects are characterized of HCI design on overall system design and approaches are identified to addressing HCI requirements in system design. The results include definition of (1) guidance based on information level requirements analysis of HCI, (2) high level requirements for a design methodology that integrates the HCI perspective into system design, and (3) requirements for embedding HCI design tools into intelligent system development environments. Author

N92-22340*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A HUMAN FACTORS EVALUATION OF THE ROBOTIC INTERFACE FOR SPACE STATION FREEDOM ORBITAL REPLACEABLE UNITS **c54**
Carlos E. Sampaio, Ellen Y. Hwang, Terence F. Fleming, Mark A. Stuart (Lockheed Engineering and Sciences Co., Houston, TX.), and A. Jay Legendre *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 539-543 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

An orbital replaceable unit (ORU) is often defined as any orbital unit aboard Space Station with a wearout life of less than 30 years. The capability of successful changeout of these units by remote manipulation is critical to the ORU to telerobot interface design. A human factors evaluation of the selected interface showed certain inadequacies of the alignment target concept that was part of the interface package. Alternative target concepts which addressed these inadequacies were developed and are presented. Recommendations will be incorporated into NASA requirements documents which ORU suppliers and manufacturers must then build to. Author

N92-22341*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
SITUATION AWARENESS IN COMMAND AND CONTROL SETTINGS Abstract Only **c53**
Robert W. Patterson *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 544 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

Many military and civilian operational settings are described as command and control (C2) environments characterized by high information load, extensive team coordination, and communication demands. To address these problems, designers have turned to the application of automation and decision aids. Currently, there are few techniques for assessing the performance of C2 operators with which to guide applications. A need exists for constructs on which to evaluate C2 systems. One possible concept for addressing these issues is that of Situation Awareness (SA). The SA concept and methodologies have developed largely around the cockpit environment. The extension is discussed of the SA concept to a team context related to C2 environments. Then the implications of such an approach for developing a methodology to empirically measure team SA in a C2 environment which should allow for the assessment of SA of both individual operators and overall SA of operational teams. The discussion also focuses on how a knowledge of SA may impact the design and development of systems which optimize rather than maximize information access and processing and, subsequently, improve C2 decision making. Author

N92-22342*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
EVALUATING HUMAN PERFORMANCE MODELING FOR SYSTEM ASSESSMENT: PROMISE AND PROBLEMS **c53**
Robert W. Patterson and Michael J. Young *In* NASA. Johnson

Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 545 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

The development and evaluation of computational human performance models is examined. An intention is to develop models which can be used to interact with system prototypes and simulations to perform system assessment. Currently LR is working on a set of models emulating cognitive, psychomotor, auditory, and visual activity for multiple operator positions of a command and control simulation system. These models, developed in conjunction with BBN Systems and Technologies, function within the simulation environment and allow for both unmanned system assessment and manned (human-in-loop) assessment of system interface and team interactions. These are relatively generic models with built-in flexibility which allows modification of some model parameters. These models have great potential for improving the efficiency and effectiveness of system design, test, and evaluation. However, the extent of the practical utility of these models is unclear. Initial verification efforts comparing model performance within the simulation to actual human operators on a similar, independent simulation have been performed and current efforts are directed at comparing human and model performance within the same simulation environment. Author

N92-22343*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
TIME MANAGEMENT DISPLAYS FOR SHUTTLE COUNTDOWN **c81**
Arthur E. Beller, H. Greg Hadaller, and Mark J. Ricci (Boeing Aerospace Co., Kennedy Space Center, FL.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 546 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05A

The Intelligent Launch Decision Support System project is developing a Time Management System (TMS) for the NASA Test Director (NTD) to use for time management during Shuttle terminal countdown. TMS is being developed in three phases: an information phase; a tool phase; and an advisor phase. The information phase is an integrated display (TMID) of firing room clocks, of graphic timelines with Ground Launch Sequencer events, and of constraints. The tool phase is a what-if spreadsheet (TMWI) for devising plans for resuming from unplanned hold situations. It is tied to information in TMID, propagates constraints forward and backward to complete unspecified values, and checks the plan against constraints. The advisor phase is a situation advisor (TMSA), which proactively suggests tactics. A concept prototype for TMSA is under development. The TMID is currently undergoing field testing. Displays for TMID and TMWI are described. Descriptions include organization, rationale for organization, implementation choices and constraints, and use by NTD.
Author

N92-22344*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
VISUALLY COUPLED SYSTEMS (VCS): THE VIRTUAL PANORAMIC DISPLAY (VPD) SYSTEM **c54**
Dean F. Kocian *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 548-561 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

The development and impact is described of new visually coupled system (VCS) equipment designed to support engineering and human factors research in the military aircraft cockpit environment. VCS represents an advanced man-machine interface (MMI). Its potential to improve aircrew situational awareness seems enormous, but its superiority over the conventional cockpit MMI has not been established in a conclusive and rigorous fashion. What has been missing is a 'systems' approach to technology advancement that is comprehensive enough to produce conclusive results concerning the operational viability of the VCS concept and verify any risk factors that might be involved with its general use in the cockpit. The advanced VCS configuration described here, was ruggedized for use in military aircraft environments and was dubbed the Virtual Panoramic Display (VPD). It was designed to answer the VCS portion of the systems problem, and is implemented as a modular system whose performance can be tailored to specific application requirements. The overall system concept and the design of the two most important electronic subsystems that support the helmet mounted parts, a new militarized version of the magnetic helmet mounted sight and correspondingly similar helmet display electronics, are discussed in detail. Significant emphasis is given to illustrating how particular design features in the hardware improve overall system performance and support research activities. Author

N92-22345*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
THE EVALUATION OF PARTIAL BINOCULAR OVERLAP ON CAR MANEUVERABILITY: A PILOT STUDY **c54**
Brian H. Tsou, Beth M. Rogers-Adams, and Charles D. Goodyear (Logicon Technical Services, Inc., Dayton, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 562-568 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

An engineering approach to enlarge the helmet mounted display (HMD) field of view (FOV) and maintain resolution and weight by partially overlapping the binocular FOV has received renewed interest among human factors scientists. It is evident, based on the brief literature review, that any panoramic display with a binocular overlap, less than a minimum amount, annoys the viewer, degrades performance, and elicits undesirable behavior. The major finding is that across the 60 deg conditions, subjects moved their heads a greater distance (by about 5 degs on each side) than in the 180 deg condition, presumably to compensate for the lack of FOV. It is quite clear that the study, based on simple car maneuverability and two subjects, reveals differences in FOV, but nothing significant between binocular overlap levels and configurations. This tentatively indicates that some tradeoffs of binocular vision for a larger overall display FOV are acceptable.
Author

N92-22346*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THREE DIMENSIONAL TRACKING WITH MISALIGNMENT BETWEEN DISPLAY AND CONTROL AXES **c54**
Stephen R. Ellis, Mitchell Tyler, Won S. Kim, and Lawrence Stark (California Univ., Berkeley.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 569-574 (For primary document see N92-22324 13-59)
(Contract NCC2-86)
Avail: NTIS HC/MF A17 CSCL 05H

Human operators confronted with misaligned display and control frames of reference performed three dimensional, pursuit tracking in virtual environment and virtual space simulations. Analysis of the components of the tracking errors in the perspective displays presenting virtual space showed that components of the error due to visual motor misalignment may be linearly separated from those associated with the mismatch between display and control coordinate systems. Tracking performance improved with several hours practice despite previous reports that such improvement did not take place. Author

N92-22347*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ANGULAR RELATION OF AXES IN PERCEPTUAL SPACE **c53**
Urs Bucher *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 575-581 Prepared in cooperation with Zurich Univ. (Switzerland) (For primary document see

N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

The geometry of perceptual space needs to be known to model spatial orientation constancy or to create virtual environments. To examine one main aspect of this geometry, the angular relation between the three spatial axes was measured. Experiments were performed consisting of a perceptual task in which subjects were asked to set independently their apparent vertical and horizontal plane. The visual background provided no other stimuli to serve as optical direction cues. The task was performed in a number of different body tilt positions with pitches and rolls varied in steps of 30 degs. The results clearly show the distortion of orthogonality of the perceptual space for nonupright body positions. Large interindividual differences were found. Deviations from orthogonality up to 25 deg were detected in the pitch as well as in the roll direction. Implications of this nonorthogonality on further studies of spatial perception and on the construction of virtual environments for human interaction is also discussed. Author

N92-22348*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AN INTELLIGENT CONTROL AND VIRTUAL DISPLAY SYSTEM FOR EVOLUTIONARY SPACE STATION WORKSTATION DESIGN c54
Xin Feng, Russell J. Niederjohn (Marquette Univ., Milwaukee, WI.), and Michael W. McGreevy *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 582-587 (For primary document see N92-22324 13-59)
(Contract NCC2-681)
Avail: NTIS HC/MF A17 CSCL 05H

Research and development of the Advanced Display and Computer Augmented Control System (ADCACS) for the space station Body-Ported Cupola Virtual Workstation (BP/VCWS) were pursued. The potential applications were explored of body ported virtual display and intelligent control technology for the human-system interfacing applications is space station environment. The new system is designed to enable crew members to control and monitor a variety of space operations with greater flexibility and efficiency than existing fixed consoles. The technologies being studied include helmet mounted virtual displays, voice and special command input devices, and microprocessor based intelligent controllers. Several research topics, such as human factors, decision support expert systems, and wide field of view, color displays are being addressed. The study showed the significant advantages of this uniquely integrated display and control system, and its feasibility for human-system interfacing applications in the space station command and control environment. Author

N92-22349*# Krug Life Sciences, Inc., San Antonio, TX.
TRACKING PERFORMANCE WITH TWO BREATHING OXYGEN CONCENTRATIONS AFTER HIGH ALTITUDE RAPID DECOMPRESSION c53
Thomas E. Nesthus, Samuel G. Schiflett, and Carolyn J. Oakley (Aerospace Medical Research Labs., Brooks AFB, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 590-594 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05I

Current military aircraft Liquid Oxygen (LOX) systems supply 99.5 pct. gaseous Aviator's Breathing Oxygen (ABO) to aircrew. Newer Molecular Sieve Oxygen Generation Systems (MSOGS) supply breathing gas concentration of 93 to 95 pct. O2. The margin is compared of hypoxia protection afforded by ABO and MSOGS breathing gas after a 5 psi differential rapid decompression (RD) in a hypobaric research chamber. The barometric pressures equivalent to the altitudes of 46000, 52000, 56000, and 60000 ft were achieved from respective base altitudes in 1 to 1.5 s decompressions. During each exposure, subjects remained at the simulated peak altitude breathing either 100 or 94 pct. O2 with positive pressure for 60 s, followed by a rapid descent to 40000 ft. Subjects used the Tactical Life Support System (TLSS) for high altitude protection. Subcritical tracking task performance on the Performance Evaluation Device (PED) provided psychomotor test measures. Overall tracking task performance results showed no differences between the MSOGS breathing O2 concentration of 94 pct. and ABO. Significance RMS error differences were found between the ground level and base altitude trials compared to peak altitude trials. The high positive breathing pressures occurring at the peak altitudes explained the differences. Author

N92-22350*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE SICKNESS PREDICTORS SUGGEST FLUID SHIFT 'NVOLVEMENT AND POSSIBLE COUNTERMEASURES c52
K. E. Simanonok, E. C. Moseley, and J. B. Charles *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 595-604 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

Preflight data from 64 first time Shuttle crew members were examined retrospectively to predict space sickness severity (NONE, MILD, MODERATE, or SEVERE) by discriminant analysis. From 9 input variables relating to fluid, electrolyte, and cardiovascular status, 8 variables were chosen by discriminant analysis that correctly predicted space sickness severity with 59 pct. success by one method of cross validation on the original sample and 67 pct. by another method. The 8 variables in order of their importance for predicting space sickness severity are sitting systolic blood pressure, serum uric acid, calculated blood volume, serum phosphate, urine osmolality, environmental temperature at the launch site, red cell count, and serum chloride. These results suggest the presence of predisposing physiologic factors to space sickness that implicate a fluid shift etiology. Addition of a 10th input variable, hours spent in the Weightless Environment Training Facility (WETF), improved the prediction of space sickness severity to 66 pct. success by the first method of cross validation on the original sample and to 71 pct. by the second method. The data suggest that WETF training may reduce space sickness severity. Author

N92-22351*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMPUTER SIMULATION OF PREFLIGHT BLOOD VOLUME REDUCTION AS A COUNTERMEASURE TO FLUID SHIFTS IN SPACE FLIGHT c52
K. E. Simanonok, R. Srinivasan, and J. B. Charles *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 605-608 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

Fluid shifts in weightlessness may cause a central volume expansion, activating reflexes to reduce the blood volume. Computer simulation was used to test the hypothesis that preadaptation of the blood volume prior to exposure to weightlessness could counteract the central volume expansion due to fluid shifts and thereby attenuate the circulatory and renal responses resulting in large losses of fluid from body water compartments. The Guyton Model of Fluid, Electrolyte, and Circulatory Regulation was modified to simulate the six degree head down tilt that is frequently use as an experimental analog of weightlessness in bedrest studies. Simulation results show that preadaptation of the blood volume by a procedure resembling a blood donation immediately before head down bedrest is beneficial in damping the physiologic responses to fluid shifts and reducing body fluid losses. After ten hours of head down tilt, blood volume after preadaptation is higher than control for 20 to 30 days of bedrest. Preadaptation also produces potentially beneficial higher extracellular volume and total body water for 20 to 30 days of bedrest. Author

N92-22352*# Aerospace Medical Research Labs., Brooks AFB, TX. High Altitude Protection Function.
THE 1990 HYPOBARIC DECOMPRESSION SICKNESS WORKSHOP: SUMMARY AND CONCLUSIONS Abstract Only c52

Andrew A. Pilmanis, Barbara J. Stegmann (Krug Life Sciences, Inc., San Antonio, TX.), and Terrell E. Scoggins *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 609 Presented at the AGARD 71st Aerospace Medical Panel Symposium, 29 Apr. - 3 May 1991, Pensacola, FL Submitted for publication (For primary document see N92-22324 13-59)
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Decompression sickness resulting from exposure to the hypobaric environment was reviewed and discussed at a three day workshop in Oct. 1990. This milestone meeting, attended by over 50 participants representing the Dept. of Defense, NASA, ESA, and academia, updated the current understanding of altitude decompression sickness (DCS). Both research and operational aspects of this illness were addressed through presentations on the pathophysiology and clinical manifestations of DCS, its incidence in aviation and space operations, and existing and proposed measures for DCS prevention. Specific areas requiring further research were also identified. A summary is presented for the material given at the workshop. Author

N92-22353*# Krug Life Sciences, Inc., San Antonio, TX.
IMPROVING SURVIVAL AFTER TISSUE VAPORIZATION (EBULLISM) Abstract Only **c52**
Barbara J. Stegmann, Andrew A. Pilmanis, and Toniann Derion (Aerospace Medical Research Labs., Brooks AFB, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 610 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

Exposure of unprotected humans to altitudes above 63,000 ft results in ebullism. Ebullism occurs when the vapor pressure of tissues is less than the ambient pressure and the tissues spontaneously 'boil'. This may result in rapid unconsciousness, cardiac vaporlock, pulmonary collapse, cerebral anoxia, and sometimes even death. Potential places for this include EVA accidents in space, aircraft experiencing rapid decompression at high altitudes with cabin or pressure suit failure, and accidents during pressure suit training exercises. The pathophysiology of ebullism was studied in the 40's to 60's using animal models. There is one report of a prolonged, unprotected human exposure and several anecdotal of unprotected short term exposures to near vacuum. In addition to pulmonary and neurologic concerns, unprotected exposure of the head may result in freezing of the corneal surface of the eye. Surface eye freezing may impair vision and significantly impact mission completion. At this time, little data are available on the effectiveness of conventional treatment protocols, such as hyperbaric oxygen, for ebullism induced injuries. Research is needed to assess the efficacy of other adjunctive therapies such as high frequency ventilation and cerebral protective drugs that are still under development. Author

N92-22354*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TOXICOLOGICAL APPROACH TO SETTING SPACECRAFT MAXIMUM ALLOWABLE CONCENTRATIONS FOR CARBON MONOXIDE **c54**
K. L. Wong, T. F. Limero (Krug Life Sciences, Inc., Houston, TX.), and J. T. James *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 612-619 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 05H

The Spacecraft Maximum Allowable Concentrations (SMACs) are exposure limits for airborne chemicals used by NASA in spacecraft. The aim of these SMACs is to protect the spacecrew against adverse health effects and performance decrements that would interfere with mission objectives. Because of the 1 and 24 hr SMACs are set for contingencies, minor reversible toxic effects that do not affect mission objectives are acceptable. The 7, 30, or 180 day SMACs are aimed at nominal operations, so they are established at levels that would not cause noncarcinogenic toxic effects and more than one case of tumor per 1000 exposed individuals over the background. The process used to set the SMACs for carbon monoxide (CO) is described to illustrate the approach used by NASA. After the toxicological literature on CO was reviewed, the data were summarized and separated into acute, subchronic, and chronic toxicity data. CO's toxicity depends on the formation of carboxyhemoglobin (COHb) in the blood, reducing the blood's oxygen carrying capacity. The initial task was to estimate the COHb levels that would not produce toxic effects in the brain and heart. Author

N92-22355*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HUMAN EXPOSURE LIMITS TO HYPERGOLIC FUELS **c52**
H. D. Garcia, J. T. James, and T. F. Limero (Krug Life Sciences, Inc., Houston, TX.) *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 620-626 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

Over the past four decades, many studies have been conducted on the toxicities of the rocket propellants hydrazine (HZ) and monomethylhydrazine (MH). Numerous technical challenges have made it difficult to unambiguously interpret the results of these studies, and there is considerable divergence between results obtained by different investigators on the inhalation concentrations (MAC's) for each toxic effect inducible by exposure to hypergolic fuels in spacecraft atmospheres, NASA undertook a critical review of published and unpublished investigations on the toxicities of these compounds. The current state of the art practices for similar studies. While many questions remain unanswered, MAC's were determined using the best available data for a variety of toxic endpoints for potential continuous exposure durations ranging from 1 hour to 180 days. Spacecraft MAC's (SMAC's) were set for each compound based on the most sensitive toxic endpoint at each exposure duration. Author

N92-22356*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HYDRAZINE MONITORING IN SPACECRAFT **c52**
J. H. Cross, S. W. Beck, T. F. Limero (Krug Life Sciences, Inc., Houston, TX.), and J. T. James *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 627-636 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

Hydrazine (HZ) and monomethyl hydrazine (MMH) are highly toxic compounds used as fuels in the Space Shuttle Orbiter Main Engines and in its maneuvering and reaction control system. Satellite refueling during a mission may also result in release of hydrazines. During extravehicular activities, the potential exists for hydrazines to contaminate the suit and to be brought into the internal atmosphere inadvertantly. Because of the high toxicity of hydrazines, a very sensitive, reliable, interference-free, and real-time method of measurement is required. A portable ion mobility spectrometer (IMS) has exhibited a low ppb detection limit for hydrazines suggesting a promising technology for the detection of hydrazines in spacecraft air. The Hydrazine Monitor is a modified airborne vapor monitor (AVM) with a custom-built datalogger. This off-the-shelf IMS was developed for the detection of chemical warfare agents on the battlefield. After early evaluations of the AVM for hydrazine measurements showed a serious interference from ammonia, the AVM was modified to measure HZ and MMH in the ppb concentration range without interference from ammonia in the low ppm range. A description of the Hydrazine Monitor and how it functions is presented. Author

N92-22357*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Toxic Hazards Div.
COMPARISON OF DERMAL AND INHALATION ROUTES OF ENTRY FOR ORGANIC CHEMICALS **c52**
Gary W. Jepson, James N. McDougal, and Harvey J. Clewell, III *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2

Feb. 1992 p 637-638 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

The quantitative comparison of the chemical concentration inside the body as the result of a dermal exposure versus an inhalation exposure is useful for assessing human health risks and deciding on an appropriate protective posture. In order to describe the relationship between dermal and inhalation routes of exposure, a variety of organic chemicals were evaluated. The types of chemicals chosen for the study were halogenated hydrocarbons, aromatic compounds, non-polar hydrocarbons and inhalation anesthetics. Both dermal and inhalation exposures were conducted in rats and the chemicals were in the form of vapors. Prior to the dermal exposure, rat fur was closely clipped and during the exposure rats were provided fresh breathing air through latex masks. Blood samples were taken during 4-hour exposures and analyzed for the chemical of interest. A physiologically based pharmacokinetic model was used to predict permeability constants (cm/hr) consistent with the observed blood concentrations of the chemical. The ratio of dermal exposure to inhalation exposure required to achieve the same internal dose of chemical was calculated for each test chemical. The calculated ratio in humans ranged from 18 for styrene to 1180 for isoflurane. This methodology can be used to estimate the dermal exposure required to reach the internal dose achieved by a specific inhalation exposure. Such extrapolation is important since allowable exposure standards are often set for inhalation exposures, but occupational exposures may be dermal. Author

N92-22358*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
OCCUPATIONAL SAFETY CONSIDERATIONS WITH HYDRAZINE Abstract Only **c52**
Harvey J. Clewell, III, James N. McDougal, Marilyn E. George, and Melvin E. Andersen *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 639 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 06P

Hydrazine is a reducing agent that is most commonly used as a propellant and as an oxygen scavenger in boilers. Hydrazine is extremely irritating and has been demonstrated to produce both acute and chronic toxicity. As a result, the established permissible inhalation exposure limits are very low, and respiration protection is required whenever vapors are present. Liquid hydrazine penetrates the skin and produces a chemical burn; therefore, some protective measures must also be taken to protect the skin from liquid contact. Often, however, a cumbersome, whole-body protective suit is worn to protect against skin contact with vapor as well. To what extent it is actually necessary to protect skin from vapor penetration had not previously been demonstrated. In an attempt to answer this question, we conducted a study with rats to compare the dermal penetration of hydrazine vapor with inhalation. Pharmacokinetic modeling was used to compare body burdens resulting from these different routes of exposure. The analysis concluded that the vapor concentration during a skin-only exposure would have to be at least 200 times higher than that during inhalation to achieve the same body burden. This type of estimation illustrates the use of predictive toxicology in occupational exposures. Author

N92-22359*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
EXPERIMENTS TO BE FLOWN IN AN EARTH ORBITING LABORATORY: THE US EXPERIMENTS ON THE FIRST INTERNATIONAL MICROGRAVITY LABORATORY, FROM CONCEPT TO FLIGHT **c12**
C. M. Winget, P. X. Callahan, R. L. Schaefer (Lockheed Engineering and Sciences Co., Moffett Field, CA.), and J. J. Lashbrook *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 642-647 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22A

The current life cycle of NASA ARC-managed flight experiments is presented. The two main purposes are: (1) to bring to the attention of biologists, and in particular cell and plant biologists, some of the requirements for flying a life science experiment in space; and (2) to introduce the subject to biologists embarking on studies in the field and to delineate some of the specific requirements that will be encountered by an ARC-managed microgravity experiment. This is not intended to be an exhaustive encyclopedia of all techniques used to prepare an experiment to evaluate the effect of microgravity on plant and animal cells. However, many of the requirements are the same for all biological systems and for other NASA centers. Emphasis is on the principle investigator's (PI's) involvement in the activities required for successful completion of major reviews. The PI support required for activities other than these reviews is also discussed, as are the interactions between ARC and the PI that will be required as problems or questions arise throughout experiment and payload development. It is impossible to predict the extent of this activity because it varies according to the complexity of the experiment and the flight experience of the PI. Author

N92-22360*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE SOLAR ARRAY MODULE PLASMA INTERACTIONS EXPERIMENT (SAMPIE): SCIENCE AND TECHNOLOGY OBJECTIVES **c20**
G. Barry Hillard *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 650-654 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10B

The Solar Array Module Plasma Interactions Experiment (SAMPIE) is an approved NASA Space Shuttle space flight experiment to be launched in Jul. 1993. The SAMPIE experiment is designed to investigate the interaction of high voltage space power systems with ionospheric plasma. To study the behavior of solar cells, a number of cell coupons, representing technologies of current interest, will be biased to high voltages to characterize both negative potential arcing and positive potential current collection. Additionally, various theories of arc suppression will be tested by including several specially modified cell coupons. Finally, SAMPIE will include experiments to study the basic nature of these interactions. The rationale for a space flight experiment, the measurements to be made, the significance of the expected results, and the current design status of the flight hardware are described. Author

N92-22361*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASCAP/LEO SIMULATIONS OF SHUTTLE ORBITER CHARGING DURING THE SAMPIE EXPERIMENT **c18**
Ricaurte Chock *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 655-661 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

The electrostatic charging of the Space Shuttle Orbiter during the operation of the Solar Array Module Plasma Interaction Experiment (SAMPIE) was modeled using the NASA Charging Analyzer Program/ low Earth orbit (NASCAP/LEO) computer code. The SAMPIE experiment consists of an array of various solar cells representing the present technologies. The objectives of the experiment are to investigate the arcing and current collection characteristics of these cells when biased to high potentials in a LEO plasma. NASCAP/LEO is a 3-D code designed to simulate the electrostatic charging of a spacecraft exposed to a plasma at LEO or ground test conditions. At its most extreme configuration, with the largest array segment of the SAMPIE experiment biased + 600 V with respect to the orbiter and facing the ram direction, the computer simulations predict that the orbiter's potential will be approximately -20 V with respect to the plasma. Author

N92-22362*# Phillips Lab., Hanscom AFB, MA.
PASP PLUS: AN EXPERIMENT TO MEASURE SPACE-ENVIRONMENT EFFECTS ON PHOTOVOLTAIC POWER SUBSYSTEMS **c20**
Donald A. Guidice *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 662-668 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10B

The Photovoltaic Array Space Power Plus Diagnostic experiment (PASP Plus) was accepted as part of the APEX Mission payload aboard a Pegastar satellite to be orbited by a Pegasus launch vehicle in late 1992. The mission's elliptical orbit will allow us to investigate both space plasma and space radiation effects. PASP Plus will have eleven types of solar arrays and a full complement of environmental and interactions diagnostic sensors. Measurements of space-plasma interactions on the various solar arrays will be made at large negative voltages (to investigate arcing parameters) and at large positive voltages (to investigate leakage currents) by biasing the arrays to various levels up to -500 and +500 volts. The long-term deterioration in solar array performance caused by exposure to space radiation will also be investigated; radiation dosage will be measured by an electron/proton dosimeter included in the environmental sensor complement. Experimental results from PASP Plus will help establish cause-and-effect relationships and lead to improved design guidelines and test standards for new-technology solar arrays. Author

N92-22363*# Physical Sciences, Inc., Andover, MA.
SOLAR CELL ARCING: THE ROLE OF OUTGASSING AND CONTAMINATION Abstract Only **c20**
W. J. Marinelli, B. D. Green, B. L. Upschulte, G. Weyl, D. Hastings, and E. Aifer (Boston Univ., MA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 669 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 10B

The effect of outgassing, venting, and thruster firing events on spacecraft system performance has been a long standing issue. Recent laboratory measurements on negatively biased high voltage solar cells at Physical Sciences Inc. (PSI) suggest that some currently designed and certainly future space power systems must address/re-evaluate this issue. Our observations show that exposing these cells to moderate levels (10 exp -3 torr-min) of H2O vapor enhances the arcing frequency, while heating to 85 C to remove water vapor significantly reduces the arc frequency. The interaction of the adhesive used to attach the cover glass to the solar cell with ambient water vapor is the key factor in determining arcing rates. Elimination of adhesive exposed to the environmental plasma reduces the arc frequency more than two orders of magnitude, and eliminates any sensitivity to H2O exposure. The adhesive may also become a source of spacecraft contamination. Macroscopic amounts were observed to blow off some arc events, and (we assume) electrostatically precipitate at other negatively biased locations. Data, analysis, and potential impact for future space platforms are discussed. Author

N92-22364*# Systems Science and Software, La Jolla, CA.
SPACECRAFT-PLASMA INTERACTION CODES: NASCAP/GEO, NASCAP/LEO, POLAR, DYNAPAC, AND EPSAT **c18**
M. J. Mandell, G. A. Jongeward, and D. L. Cooke (Phillips Lab., Hanscom AFB, MA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 672-679 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

Development of a computer code to simulate interactions between the surfaces of a geometrically complex spacecraft and the space plasma environment involves: (1) defining the relevant physical phenomena and formulating them in appropriate levels of approximation; (2) defining a representation for the 3-D space external to the spacecraft and a means for defining the spacecraft surface geometry and embedding it in the surrounding space; (3) packaging the code so that it is easy and practical to use, interpret, and present the results; and (4) validating the code by continual comparison with theoretical models, ground test data, and spaceflight experiments. The physical content, geometrical capabilities, and application of five S-CUBED developed spacecraft plasma interaction codes are discussed. The NASA Charging Analyzer Program/geosynchronous earth orbit (NASCAP/GEO) is used to illustrate the role of electrostatic barrier formation in daylight spacecraft charging. NASCAP/low Earth orbit (LEO) applications to the CHARGE-2 and Space Power Experiment Aboard Rockets (SPEAR)-1 rocket payloads are shown. DynaPAC application to the SPEAR-2 rocket payloads is described. Environment Power System Analysis Tool (EPSAT) is illustrated by application to Tethered Satellite System 1 (TSS-1), SPEAR-3, and Sundance. A detailed description and application of the Potentials of Large Objects in the Auroral Region (POLAR) Code are presented. Author

N92-22365*# Sverdrup Technology, Inc., Brook Park, OH.
A COMPARISON OF TWO PLASMA MODELS **c75**
Russell Cottam *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 680-689 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20I

The time dependent behavior of a plasma which surrounds a highly biased conducting sphere is considered. This plasma is treated as either a cold two component fluid or as a warm plasma whose time development can be found by solving the Vlasov equation. Both models demonstrate oscillatory behavior, but the electric fields predicted by the models are quantitatively quite different in regions close to the surface of the sphere and very similar otherwise. A broadening of the electron distribution function with time is observed indicating local heating of the plasma near the surface of the sphere. Author

N92-22366*# Phillips Lab., Hanscom AFB, MA.
VALIDATION AND APPLICATIONS OF THE POLAR CODE Abstract Only **c18**
David L. Cooke, Ira Katz, Gary Jongeward, John R. Lilley, Jr., and Maurice Tautz (RADEX, Inc., Bedford, MA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 690 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

The Potentials of Large Objects in the Auroral Region (POLAR) code was written to model the charging of large spacecraft by auroral electrons in low polar orbit. It has also proven to be a powerful tool for analysis of active and voltage-plasma interactions. POLAR combines 3-D object definition, direct solution to Poisson's equation, space charge transport, and surface charge computation. Physical effects treated by POLAR include the plasma wake and ram, the geomagnetic field, ionization, sheath and barrier formation, and photo and secondary electron generation and transport. Polar development is complete and it is now available to the aerospace community. The methodology of POLAR is reviewed but concentration is on the applications of POLAR to physical problems and observations with the intent of demonstrating both the code's capabilities, and its limitations. These applications include the Space Shuttle, the Defense Meteorological Satellite Program (DMSP) satellites, sounding rockets, plasma chamber experiments, and things not yet flown. Author

N92-22367*# TRW Defense and Space Systems Group, Redondo Beach, CA.
APPLICATION OF ENGINEERING CODES TO THE ASSESSMENT OF SPACECRAFT CHARGING INDUCED HAZARDS Abstract Only **c18**
N. J. Stevens and M. R. Jones *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 691 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 22B

One of the major hurdles to developing a better understanding of the environmentally induced interactions in spacecraft systems (spacecraft charging) is the lack of simple tools to analyze the behavior of the spacecraft in a sub-storm environment. The available tool, NASA Charging Analyzer Program (NASCAP), is expensive to use and treats only half of the problem - surface effects only. In response to this need, we have developed, under our IRAD Program, a set of engineering tools that operate on personal computers and addresses both the surface and bulk charging aspects of the interactions. These engineering codes utilize circuit analysis techniques and model simplifications to allow rapid computations. The codes were compared to both NASCAP predictions and to bulk charging data with excellent agreement for both phenomena. The models used in our engineering codes are shown, and in the engineering codes, the models are defined in terms of plates or triangles in an unconfined space. The predictions are based upon current balances to each plate. The code has routines to allow interactions between the plates to simulate 'barrier' effects. The agreement for the predicted differential surface voltages for the model is given. In conducting the comparison of engineering codes to NASCAP predictions, it was found that some inconsistencies existed in the NASCAP code that are not obvious to the user. The use of the grid imposes constraints that voltage gradients exist between the grid points. This allows the existence of voltage gradients in conductors and influences surface resistivity predictions. These points are discussed along with the predictions for treating these inconsistencies properly. The model predictions for a variable intensity substorm is also presented. Author

N92-22368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ION COLLECTION FROM A PLASMA BY A PINHOLE c75

David B. Snyder and Joel L. Herr (Sverdrup Technology, Inc., Cleveland, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 694-702 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 20I

Ion focusing by a biased pinhole is studied numerically. Laplace's equation is solved in 3-D for cylindrical symmetry on a constant grid to determine the potential field produced by a biased pinhole in a dielectric material. Focusing factors are studied for ions of uniform incident velocity with a 3-D Maxwellian distribution superimposed. Ion currents to the pinhole are found by particle tracking. The focusing factor of positive ions as a function of initial velocity, temperature, injection radius, and hole size is reported. For a typical Space Station Freedom environment (oxygen ions having a 4.5 eV ram energy, 0.1 eV temperature, and a -140 V biased pinhole), a focusing factor of 13.35 is found for a 1.5 mm radius pinhole. Author

N92-22369*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EXPERIMENTAL BREAKDOWN OF SELECTED ANODIZED ALUMINUM SAMPLES IN DILUTE PLASMAS c75

Norman T. Grier and Stanley Domitz *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 703-709 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 20I

Anodized aluminum samples representative of Space Station Freedom structural material were tested for electrical breakdown under space plasma conditions. In space, this potential arises across the insulating anodized coating when the spacecraft structure is driven to a negative bias relative to the external plasma potential due to plasma-surface interaction phenomena. For anodized materials used in the tests, it was found that breakdown voltage varied from 100 to 2000 volts depending on the sample. The current in the arcs depended on the sample, the capacitor, and the voltage. The level of the arc currents varied from 60 to 1000 amperes. The plasma number density varied from 3 x 10 exp 6 to 10 exp 3 ions per cc. The time between arcs increased as the number density was lowered. Corona testing of anodized samples revealed that samples with higher corona inception voltage had higher arcing inception voltages. From this it is concluded that corona testing may provide a method of screening the samples. Author

N92-22370*# Sverdrup Technology, Inc., Cleveland, OH.

THEORETICAL MODELS OF KAPTON HEATING IN SOLAR ARRAY GEOMETRIES c44

Thomas L. Morton *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 710-715 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 10A

In an effort to understand pyrolysis of Kapton in solar arrays, a computational heat transfer program was developed. This model allows for the different materials and widely divergent length scales of the problem. The present status of the calculation indicates that thin copper traces surrounded by Kapton and carrying large currents can show large temperature increases, but the other configurations seen on solar arrays have adequate heat sinks to prevent substantial heating of the Kapton. Electron currents from the ambient plasma can also contribute to heating of thin traces. Since Kapton is stable at temperatures as high as 600 C, this indicates that it should be suitable for solar array applications. There are indications that the adhesive sued in solar arrays may be a strong contributor to the pyrolysis problem seen in solar array vacuum chamber tests. Author

N92-22371*# Case Western Reserve Univ., Cleveland, OH. Dept. of Physics.

SPUTTERING OF IONS FROM Cu AND Al BY LOW ENERGY OXYGEN ION BOMBARDMENT Abstract Only c26

T. G. Eck, L.-Y. Chen, and R. W. Hoffman *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 716 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 11F

The sputtering of Cu(+) and Al(+) ions from copper and aluminum while the target surface is bombarded with low energy oxygen ions (20 to 500 eV), is investigated. Both the ion yield, as a function of oxygen ion energy, and the kinetic energy distribution of the sputtered ions at a given oxygen ion energy are determined. Author

N92-22372*# Northeastern Univ., Boston, MA. Dept. of Electrical and Computer Engineering.

LABORATORY STUDY OF THE TEMPORAL EVOLUTION OF THE CURRENT-VOLTAGE CHARACTERISTIC OF A PROBE IN THE WAKE OF AN OBJECT IMMERSED IN A PULSED FLOWING PLASMA c33

S. Meassick and C. Chan *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 718-723 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 09C

Measurements of the current-voltage characteristics of a Langmuir probe in the near wake of a disk immersed in a pulsed flowing plasma were made. A 1 cm diameter biasable sphere was placed in the ion-free near wake region of a 10 cm diameter disk immersed in a Mach 8 pulsed flowing plasma. The current-voltage characteristic of the sphere was observed as a function of time as the sphere bias was scanned from -5000 V to +1000 V. The collected current is found to be monotonically increasing with increasing positive bias voltage but exhibits a threshold voltage for current collection as the bias voltage becomes more negative. Potential measurements in the wake region were made for a sphere bias voltages below, at, and above the current collection threshold for a number of times during the wake formation period. The time evolution of the potential profile is shown to change as the sheath around the biased sphere is established. Predictions from the particle trajectory code SIMION are compared with data, showing

excellent agreement in the prediction of the current collection threshold. Author

N92-22373*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CURRENT FLOW IN A PLASMA CAUSED BY DIELECTRIC BREAKDOWN **c75**

J. A. Vaughn, M. R. Carruth, Jr., and P. A. Gray (Sverdrup Technology, Inc., Huntsville, AL.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 724-731 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 20I

Spacecraft with a thin dielectric coating on the outer surface of the structure which are biased (-200 V) negative relative to the atmospheric plasma are susceptible to dielectric breakdown. This paper will present experimental tests designed to measure the electron current flow from the structure through the plasma during the arc. The current path was examined in three parts: the electrons supplied through the structure and the arc to the outer structure, the expansion of the arc into the ambient plasma, and the return current through the ambient plasma. The measured electron current either flowing from the plasma or supplied to the plasma by the arc in each case was compared to the random thermal electron current which could be collected. The results of the tests show a spacecraft is capable of supporting arcs with peak currents greater than thermal electron currents, and these currents will be dependent upon the amount of stored charge in the structure (i.e., the structure's surface area and dielectric thickness). Also, the results of these tests show that it is possible for structures with a self capacitance of 10 microFarads to see peak currents of 90 A and structures with 1000 microFarads (i.e., capacitance of one Space Station Freedom module) to produce peak currents of 1000 A. Author

N92-22374*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ELECTROSTATIC EFFECTS ON DUST PARTICLES IN SPACE Abstract Only **c33**

Philip Leung and Ralph Wuerker *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 732 Sponsored in part by JPL, California Inst. of Technology, Pasadena (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 10C

The star scanner of the Magellan spacecraft experienced operational anomalies continuously during Magellan's journey to Venus. These anomalies were attributed to the presence of dust particles in the vicinity of the spacecraft. The dust particles, which were originated from the surface of thermal blankets, were liberated when the electrostatic force acting on them was of sufficient magnitude. In order to verify this hypothesis, an experimental program was initiated to study the mechanisms responsible for the release of dust particles from a spacecraft surface. In the experiments, dust particles were immersed in a plasma and/or subjected to ultra-violet irradiation. Results showed that the charging state of a dust particle was strongly dependent on the environment, and the charge on a dust particle was approximately 10(exp 3) elementary charges. Consequently, in the space environment, electrostatic force could be the most dominant force acting on a dust particle. Author

N92-22375*# Orion International Technologies, Albuquerque, NM.

THE ASSESSMENT OF LONG-TERM ORBITAL DEBRIS MODELS **c12**

F. M. Jonas and K. W. Yates *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 734-741 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 22A

Existing long-term orbital debris models are assessed as a first step in the Air Force's effort to develop an Air Force long-term orbital debris model which can perform the following functions: (1) operate with the necessary accuracy at the relevant altitudes and orbital parameters; (2) benefit from new Air Force and non-Air Force debris measurements; and (3) accommodate current and future Air Force space scenarios. Model assessment results are shown for the NASA engineering model. The status of the NASA EVOLVE model assessment is discussed. Author

N92-22376*# Phillips Lab., Kirkland AFB, NM. Space Kinetic Impact and Debris Branch.

SPACE DEBRIS CHARACTERIZATION IN SUPPORT OF A SATELLITE BREAKUP MODEL **c12**

Bryan H. Fortson, James E. Winter, and Firooz A. Allahdadi *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 742-749 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 22A

The Space Kinetic Impact and Debris Branch began an ambitious program to construct a fully analytical model of the breakup of a satellite under hypervelocity impact. In order to provide empirical data with which to substantiate the model, debris from hypervelocity experiments conducted in a controlled laboratory environment were characterized to provide information of its mass, velocity, and ballistic coefficient distributions. Data on the debris were collected in one master data file, and a simple FORTRAN program allows users to describe the debris from any subset of these experiments that may be of interest to them. A statistical analysis was performed, allowing users to determine the precision of the velocity measurements for the data. Attempts are being made to include and correlate other laboratory data, as well as those data obtained from the explosion or collision of spacecraft in low earth orbit. Author

N92-22377*# Phillips Lab., Kirkland AFB, NM. Space Kinetic Impact and Debris Branch.

ANALYSIS OF ENERGY DISSIPATION AND DEPOSITION IN ELASTIC BODIES IMPACTING AT HYPERVELOCITIES **c39**

David F. Medina and Firooz A. Allahdadi *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 750-755 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 20K

A series of impact problems were analyzed using the Eulerian hydrocode CTH. The objective was to quantify the amount of energy dissipated locally by a projectile-infinite plate impact. A series of six impact problems were formulated such that the mass and speed of each projectile were varied in order to allow for increasing speed with constant kinetic energy. The properties and dimensions of the plate were the same for each projectile impact. The resulting response of the plate was analyzed for global Kinetic Energy, global momentum, and local maximum shear stress. The percentage of energy dissipated by the various hypervelocity impact phenomena appears as a relative change of shear stress at a point away from the impact in the plate. Author

N92-22378*# Phillips Lab., Hanscom AFB, MA. Geophysics Directorate.

SPACE DEBRIS MEASUREMENT PROGRAM AT PHILLIPS LABORATORY **c12**

Phan D. Dao and Ross T. McNutt *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 756 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 22A

Ground-based optical sensing was identified as a technique for measuring space debris complementary to radar in the critical debris size range of 1 to 10 cm. The Phillips Laboratory is building a staring optical sensor for space debris measurement and considering search and track optical measurement at additional sites. The staring sensor is implemented in collaboration with Wright Laboratory using the 2.5 m telescope at Wright Patterson AFB, Dayton, Ohio. The search and track sensor is designed to detect

and track orbital debris in tasked orbits. A progress report and a discussion of sensor performance and search and track strategies will be given. Author

N92-22379*# Naval Research Lab., Washington, DC. Space Plasma Branch.

DEBRIS AND MICROMETEORITE IMPACT MEASUREMENTS IN THE LABORATORY c12

J. Resnick, J. Grun, J. Crawford, R. Burris (Physical Sciences, Inc., Alexandria, VA.), C. K. Manka, J. L. Ford, and B. H. Ripin *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 758-762 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 22A

A method was developed to simulate space debris in the laboratory. This method, which is an outgrowth of research in inertial confinement fusion (ICF), uses laser ablation to accelerate material. Using this method, single 60 micron aluminum spheres were accelerated to 15 km/sec and larger 500 micron aluminum spheres were accelerated to 2 km/sec. Also, many small (less than 10 micron diameter) irregularly shaped particles were accelerated to speeds of 100 km/sec. D.R.D.

N92-22380*# New Mexico Inst. of Mining and Technology, Socorro. Center for Explosives Technology Research.

SIMULATING HYPERVELOCITY IMPACT EFFECTS ON STRUCTURES USING THE SMOOTHED PARTICLE HYDRODYNAMICS CODE MAGI c39

Larry Libersky, Firooz A. Allahdadi, and Theodore C. Carney (Advanced Sciences, Inc., Albuquerque, NM.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 763-776 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 20K

Analysis of interaction occurring between space debris and orbiting structures is of great interest to the planning and survivability of space assets. Computer simulation of the impact events using hydrodynamic codes can provide some understanding of the processes but the problems involved with this fundamental approach are formidable. First, any realistic simulation is necessarily three-dimensional, e.g., the impact and breakup of a satellite. Second, the thickness of important components such as satellite skins or bumper shields are small with respect to the dimension of the structure as a whole, presenting severe zoning problems for codes. Thirdly, the debris cloud produced by the primary impact will yield many secondary impacts which will contribute to the damage and possible breakup of the structure. The problem was approached by choosing a relatively new computational technique that has virtues peculiar to space impacts. The method is called Smoothed Particle Hydrodynamics. D.R.D.

N92-22381*# Phillips Lab., Hanscom AFB, MA. Space Physics Div.

RADIATION-INDUCED INSULATOR DISCHARGE PULSES IN THE CRRES INTERNAL DISCHARGE MONITOR SATELLITE EXPERIMENT c33

A. R. Frederickson, E. G. Mullen, D. H. Brautigam, and K. J. Kerns *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 778-784 Prepared in cooperation with Boston Coll., Chestnut Hill, MA (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 09C

The Internal Discharge Monitor (IDM) was designed to observe electrical pulses from common electrical insulators in space service. The sixteen insulator samples included twelve planar printed circuit boards and four cables. The samples were fully enclosed, mutually isolated, and space radiation penetrated 0.02 cm of aluminum before striking the samples. Pulsing began on the seventh orbit, the maximum pulse rate occurred on the seventeenth orbit when 13 pulses occurred, and the pulses slowly diminished to about one per 3 orbits six months later. After 8 months, the radiation belts abruptly increased and the pulse rates attained a new high. These pulse rates were in agreement with laboratory experience on shorter time scales. Several of the samples never pulsed. If the pulses were not confined within IDM, the physical processes could spread to become a full spacecraft anomaly. The IDM results indicate the rate at which small insulator pulses occur. Small pulses are the seeds of larger satellite electrical anomalies. The pulse rates are compared with space radiation intensities, L shell location, and spectral distributions from the radiation spectrometers on the Combined Release and Radiation Effects Satellite. Author

N92-22382*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ENVIRONMENTAL INTERACTIONS IN SPACE EXPLORATION: ENVIRONMENTAL INTERACTIONS WORKING GROUP c45

Joseph C. Kolecki and G. Barry Hillard *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 785-787 Previously announced as N92-17069 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 13B

With the advent of the Space Exploration Initiative, the possibility of designing and using systems on scales heretofore unattempted presents exciting new challenges in systems design and space science. The environments addressed by the Space Exploration Initiative include the surfaces of the Moon and Mars, as well as the varied plasma and field environments which will be encountered by humans and cargo enroute to these destinations. Systems designers will need to understand environmental interactions and be able to model these mechanisms from the earliest conceptual design stages through design completion. To the end of understanding environmental interactions and establishing robotic precursor mission requirements, an Environmental Interactions Working Group was established as part of the Robotic Missions Working Group. The working group is described, and its current activities are updated. Author

N92-22383*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

MEDIUM RESOLUTION SPECTRA OF THE SHUTTLE GLOW IN THE VISIBLE REGION OF THE SPECTRUM Abstract Only c16

R. A. Viereck, E. Murad, C. P. Pike, S. B. Mende, G. R. Swenson (Lockheed Missiles and Space Co., Palo Alto, CA.), F. L. Culbertson, and B. C. Springer *In its* 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 78 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 22B

Recent spectral measurements of the visible shuttle glow (lambda = 400 - 800 nm) at medium resolution (1 nm) reveal the same featureless continuum with a maximum near 680 nm that was reported previously. This is also in good agreement with recent laboratory experiments that attribute the glow to the emissions of NO2 formed by the recombination of O + NO. The data that are presented were taken from the aft flight deck with a hand-held spectrograph and from the shuttle bay with a low-light-level television camera. Shuttle glow images and spectra are presented and compared with laboratory data and theory. Author

N92-22384*# Science Applications International Corp., Glendora, CA.

A COMPARISON OF SHUTTLE VERNIER ENGINE PLUME CONTAMINATION WITH CONTAM 3.4 CODE PREDICTIONS Abstract Only c20

Carl R. Maag, Thomas M. Jones, Shankar M. Rao, and W. Kelly Linder (Space Systems Div. AFSC Field Office, Houston, TX.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 789 (For primary document see N92-22324 13-59)

Avail: NTIS HC/MF A17 CSCL 21H

In 1985, using the CONTAM 3.2 code, it was predicted that

the shuttle Primary Reaction Control System (PRCS) and Vernier Reaction Control System (VRCS) engines could be potential contamination sources to sensitive surfaces located within the shuttle payload bay. Spaceflight test data on these engines is quite limited. Shuttle mission STS-32, the Long Duration Exposure Facility retrieval mission, was instrumented with an experiment that provided the design engineer with evidence that contaminant species from the VRCS engines can enter the payload bay. More recently, the most recent version of the analysis code, CONTAM 3.4, has re-examined the contamination potential of these engines. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-22141*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONVEX MINI MANUAL
Geoffrey M. Tennille, Lona M. Howser, Eric L. Everton, Catherine K. Cronin, Margaret H. LaMarsh, Judith A. Utley, Brenda A. Austin, and Theresa M. Flynn (Unisys Corp., Hampton, VA.) Feb. 1992 49 p
(NASA-TM-107564; NAS 1.15:107564; CSCC-Doc-CX-1e) Avail: NTIS HC/MF A03 CSCL 09B

The use is described of the CONVEX computers that are an integral part of the Supercomputing Network Subsystem (SNS) of the Central Scientific Computing Complex of NASA Langley. Features of the CONVEX computers that are significantly different that the Cray supercomputers are covered, including: FORTRAN, C, architecture of the CONVEX computers, the CONVEX environment, batch job submittal, debugging, performance analysis, utilities unique to CONVEX and documentation. Author

N92-22142*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SNS PROGRAMMING ENVIRONMENT USER'S GUIDE
Geoffrey M. Tennille, Lona M. Howser, D. Creig Humes, Catherine K. Cronin, John T. Bowen, Joseph M. Drozdowski, Judith A. Utley, Theresa M. Flynn, and Brenda A. Austin (Unisys Corp., Hampton, VA.) Feb. 1992 77 p
(NASA-TM-107565; NAS 1.15:107565; CSCC-Doc-A-8a) Avail: NTIS HC/MF A05 CSCL 09B

The computing environment is briefly described for the Supercomputing Network Subsystem (SNS) of the Central Scientific Computing Complex of NASA Langley. The major SNS computers are a CRAY-2, a CRAY Y-MP, a CONVEX C-210, and a CONVEX C-220. The software is described that is common to all of these computers, including: the UNIX operating system, computer graphics, networking utilities, mass storage, and mathematical libraries. Also described is file management, validation, SNS configuration, documentation, and customer services. Author

N92-22174# Mitre Corp., Bedford, MA.
FINE GRAINED LABELING. VOLUME 1: OPERATING SYSTEM SUPPORT
Jeffrey Picciotto and Daniel F. Vukelich Nov. 1991 53 p
(AD-A244579; MTP-387-Vol-1) Avail: NTIS HC/MF A04 CSCL 12/8

Trusted computer systems, such as compartmented mode workstations or systems that meet the B-level criteria of the Department of Defense Trusted Computer System Evaluation Criteria, provide a wealth of security-related functionality. In the area of labeling and access control, however, they fall somewhat short. This is because they only provide file-level labeling and access control. Many trusted applications currently envisioned, or under development, rely on a finer granularity of labeling and access control. Such applications include editors that support paragraph markings, message processing systems that label and protect individual messages, and so forth. This paper describes the design and prototype implementation of a general-purpose fine grained labeling and access control mechanism as part of a trusted operating system. The results presented herein indicate that the labeling and access control functionality applications required can be provided in a practical manner with relatively few modifications to the underlying trusted operating system. The resulting benefits to applications, namely reduced size, complexity, and dependence on system-specific security interfaces, suggest that operating system support for fine grained labeling and access control simplifies the design and implementation of such applications while enhancing their portability and minimizing software integration issues. GRA

N92-22192*# Boeing Military Airplane Development, Seattle, WA.
FORMAL VERIFICATION OF A SET OF MEMORY MANAGEMENT UNITS
E. Thomas Schubert, K. Levitt (California Univ., Davis.), and Gerald C. Cohen Mar. 1992 93 p
(Contract NAS1-18586)
(NASA-CR-189566; NAS 1.26:189566) Avail: NTIS HC/MF A05 CSCL 09B

This document describes the verification of a set of memory management units (MMU). The verification effort demonstrates the use of hierarchical decomposition and abstract theories. The MMUs can be organized into a complexity hierarchy. Each new level in the hierarchy adds a few significant features or modifications to the lower level MMU. The units described include: (1) a page check translation look-aside module (TLM); (2) a page check TLM with supervisor line; (3) a base bounds MMU; (4) a virtual address translation MMU; and (5) a virtual address translation MMU with memory resident segment table. Author

N92-22213*# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Computer Science.
CONTENT ADDRESSABLE MEMORY PROJECT Semiannual Progress Report, Sep. 1991 - Feb. 1992
J. Storrs Hall, Saul Levy, Donald E. Smith, and Keith M. Miyake 1 Mar. 1992 119 p
(Grant NAG2-668)
(NASA-CR-190202; NAS 1.26:190202) Avail: NTIS HC/MF A06 CSCL 09B

A parameterized version of the tree processor was designed and tested (by simulation). The leaf processor design is 90 percent complete. We expect to complete and test a combination of tree and leaf cell designs in the next period. Work is proceeding on algorithms for the computer aided manufacturing (CAM), and once the design is complete we will begin simulating algorithms for large problems. The following topics are covered: (1) the practical implementation of content addressable memory; (2) design of a LEAF cell for the Rutgers CAM architecture; (3) a circuit design tool user's manual; and (4) design and analysis of efficient hierarchical interconnection networks. Author

N92-22440*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Center for Space Microelectronics Technology.
NON-VOLATILE, HIGH DENSITY, HIGH SPEED, MICROMAGNET-HALL EFFECT RANDOM ACCESS MEMORY (MHRAM)
Jiin C. Wu, Romney R. Katti, and Henry L. Stadler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 139-146 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-22097# Rolls-Royce Ltd., Derby (England). Electronics and Measurement Techniques Dept.
THE APPLICATION OF CASE TOOLS IN REAL-TIME CONTROL PROJECTS
T. A. Curran 24 Apr. 1991 4 p Presented at the IEE Colloquium, 24 Apr. 1991
(PNR-90863; ETN-92-90804) Copyright Avail: NTIS HC/MF A01

Prior to the introduction of CASE (Computer Assisted Systems Engineering) tools as departmental policy, all software design was accomplished using classical methods, such as flow charts and pseudo code. While this was time consuming, it had the advantage of producing programs from the outset. As the integrity of software began to play a more important role in the design of real time control systems, it was obvious that a new design approach was required which would give software the visibility enjoyed by hardware. It is impossible to effectively manage a software project without this visibility, and with the added complexity of multi-processors often found in real time control, any solution must be viable and easily maintainable. The decision to utilize CASE tools in place of a pen and paper approach, was an obvious one. Not only could the speed of the analysis and design be improved, but the greater flexibility in building and altering the model diagrams offered significant improvement in productivity. The software tools could also check the design faster and more stringently than manual methods. This provides software designers with a model which is of much higher integrity and complies with company software quality requirements which are the 'yard sticks' used to measure software. The application of CASE tools to a small system testing facility is reviewed and the pros and cons higlighted. ESA

N92-22124# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
IDENTIFICATION OF LINEAR AND NONLINEAR CONTINUOUS TIME MODELS FROM SAMPLED DATA SETS
K. M. Tsang (Hong Kong Polytechnic, Kowloon.) and S. A. Billings Sep. 1991 42 p
(RR-437; ETN-92-91093) Avail: NTIS HC/MF A03

The identification of continuous time linear and nonlinear models from sampled data records is investigated and a new recursive orthogonal algorithm is derived. An integral equation formulation is shown to be appropriate and enhancement of the parameter estimates using data prefiltering is demonstrated for noise corrupted data sets. Simulated examples are included to illustrate the methods. ESA

N92-22158*# Research Inst. for Computing and Information Systems, Houston, TX.
MITT WRITER AND MITT WRITER ADVANCED DEVELOPMENT: DEVELOPING AUTHORING AND TRAINING SYSTEMS FOR COMPLEX TECHNICAL DOMAINS Final Report
Bradley J. Wiederholt, Elica J. Browning, Jeffrey E. Norton, and William B. Johnson Apr. 1991 59 p Prepared in cooperation with Galaxy Scientific Corp., Atlanta, GA
(Contract NCC9-16; RICIS Proj. ET-21; RICIS Proj. ET-22)
(NASA-CR-190171; NAS 1.26:190171) Avail: NTIS HC/MF A04 CSCL 09B

MITT Writer is a software system for developing computer based training for complex technical domains. A training system produced by MITT Writer allows a student to learn and practice troubleshooting and diagnostic skills. The MITT (Microcomputer Intelligence for Technical Training) architecture is a reasonable approach to simulation based diagnostic training. MITT delivers training on available computing equipment, delivers challenging training and simulation scenarios, and has economical development and maintenance costs. A 15 month effort was undertaken in which the MITT Writer system was developed. A workshop was also conducted to train instructors in how to use MITT Writer. Earlier versions were used to develop an Intelligent Tutoring System for troubleshooting the Minuteman Missile Message Processing System. Author

N92-22170# Mitre Corp., Bedford, MA.
THE SERIAL PRODUCT OF CONTROLLED SIGNALLING SYSTEMS
Jonathan T. Trostle Dec. 1991 41 p
(Contract DAAB07-91-C-N751)
(AD-A244576; MTR-10993) Avail: NTIS HC/MF A03 CSCL 25/5

The controlled signalling system is a finite-state deterministic model of information disclosure in a computer system. The model includes high-level and low level cooperating processes. The processes cooperate to covertly send data from the high-level process (transmitter) to the low-level process (receiver). The capacity of a controlled signalling system is a measure of the amount of information the high-level process can disclose to the low-level process. The serial product is a binary operation on the class of controlled signalling systems. The capacity of the serial product of two controlled signalling systems can be strictly greater than the capacities of the individual systems. The r-controlled signalling systems are a subclass of controlled signalling systems; for r-controlled signaling systems, the serial product capacity is the maximum of the individual capacities. GRA

N92-22188*# Nebraska Univ., Lincoln.
COMPRESSION OF DIGITAL IMAGES OVER LOCAL AREA NETWORKS. APPENDIX 1: ITEM 3 M.S. Thesis
Bhargavi Gorjala Aug. 1991 108 p
(Grant NAG5-916)
(NASA-CR-189958; NAS 1.26:189958) Avail: NTIS HC/MF A06 CSCL 09B

Differential Pulse Code Modulation (DPCM) has been used with speech for many years. It has not been as successful for images because of poor edge performance. The only corruption in DPC is quantizer error but this corruption becomes quite large in the region of an edge because of the abrupt changes in the statistics of the signal. We introduce two improved DPCM schemes; Edge correcting DPCM and Edge Preservation Differential Coding. These two coding schemes will detect the edges and take action to correct them. In an Edge Correcting scheme, the quantizer error for an edge is encoded using a recursive quantizer with entropy coding and sent to the receiver as side information. In an Edge Preserving scheme, when the quantizer input falls in the overload region, the quantizer error is encoded and sent to the receiver repeatedly until the quantizer input falls in the inner levels. Therefore these coding schemes increase the bit rate in the region of an edge and require variable rate channels. We implement these two variable rate coding schemes on a token wing network. Timed token protocol supports two classes of messages; asynchronous and synchronous. The synchronous class provides a pre-allocated bandwidth and guaranteed response time. The remaining bandwidth is dynamically allocated to the asynchronous class. The Edge Correcting DPCM is simulated by considering the edge information under the asynchronous class. For the simulation of the Edge Preserving scheme, the amount of information sent each time is fixed, but the length of the packet or the bit rate for that packet is chosen depending on the availability capacity. The performance of the network, and the performance of the image coding algorithms, is studied. Author

N92-22216# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Aerodynamics.
THREE-DIMENSIONAL MULTIGRID ALGORITHM FOR THE EULER AND THE THIN-LAYER NAVIER-STOKES EQUATIONS
T. Siikonen 30 Mar. 1991 33 p
(PB92-134329; SER-A-91-A12; ISBN-951-22-0602-3) Avail: NTIS HC/MF A03 CSCL 09B

The 3-D thin-layer Navier-Stokes equations are solved in a finite-volume form. The scheme is cell-centered and the fluxes on

the cell boundary are calculated applying the flux-vector splitting method of Van Leer or the flux-differnce splitting of Roe. The equations are solved by an LU-factored implicit time integration method with multigrid acceleration of convergence. The method is applied for calculating inviscid and viscous flows around the ONERA M6 wing. Turbulent viscosity is evaluated by an algebraic model. The simulations are compared with the results obtained elsewhere as well as with experimental data. These comparisons demonstrate the accuracy and efficiency of the method. GRA

N92-22243 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
TRAINING PERCEPTRONS BY LINEAR PROGRAMMING
A. J. Mansfield Aug. 1991 25 p
(NPL-DITC-181/91; ISSN-0262-5369; ETN-92-91199) Copyright Avail: National Physical Lab., Teddington, Middlesex TW11 0LW, England

The performance of the perceptron convergence procedure, and other training methods, are compared with that of using a linear programming algorithm to train perceptrons. It is shown that the ellipsoid method for linear programming can be implemented in a version of the perceptron to be trained. The result is a local perceptron training method for which the number of training cycles needed is bounded by a polynomial of input units. When the training vectors are from the set plus or minus 1 to the nth power, this method needs O(n cubed) log(n) training cycles. In contrast, the number of training cycles needed by the perceptron convergence procedure can increase exponentially in the number of input units. In an empirical comparison of the training methods, using randomly generated training sets, the method based on linear programming required significantly fewer training cycles in the majority of the cases tested. ESA

N92-22280*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PROGRAMMING IN VIENNA FORTRAN Final Report
Barbara Chapman, Piyush Mehrotra, and Hans Zima (Wien Univ., Austria) Mar. 1992 41 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189623; ICASE-92-9; NAS 1.26:189623) Avail: NTIS HC/MF A03 CSCL 09B

Exploiting the full performance potential of distributed memory machines requires a careful distribution of data across the processors. Vienna Fortran is a language extension of Fortran which provides the user with a wide range of facilities for such mapping of data structures. In contrast to current programming practice, programs in Vienna Fortran are written using global data references. Thus, the user has the advantages of a shared memory programming paradigm while explicitly controlling the data distribution. In this paper, we present the language features of Vienna Fortran for FORTRAN 77, together with examples illustrating the use of these features. Author

N92-22390*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
THE DESIGN AND IMPLEMENTATION OF A PARALLEL UNSTRUCTURED EULER SOLVER USING SOFTWARE PRIMITIVES Final Report
R. Das, D. J. Mavriplis, J. Saltz, S. Gupta, and R. Ponnusamy Mar. 1992 27 p Presented at the AIAA Conference, Reno, NV, 1992 Previously announced in IAA as A92-28206
(Contract NAS1-18605)
(NASA-CR-189625; NAS 1.26:189625; ICASE-92-12) Avail: NTIS HC/MF A03 CSCL 09B

This paper is concerned with the implementation of a three-dimensional unstructured grid Euler-solver on massively parallel distributed-memory computer architectures. The goal is to minimize solution time by achieving high computational rates with a numerically efficient algorithm. An unstructured multigrid algorithm with an edge-based data structure has been adopted, and a number of optimizations have been devised and implemented in order to accelerate the parallel communication rates. The implementation is carried out by creating a set of software tools, which provide an interface between the parallelization issues and the sequential code, while providing a basis for future automatic run-time compilation support. Large practical unstructured grid problems are solved on the Intel iPSC/860 hypercube and Intel Touchstone Delta machine. The quantitative effect of the various optimizations are demonstrated, and we show that the combined effect of these optimizations leads to roughly a factor of three performance improvement. The overall solution efficiency is compared with that obtained on the CRAY-YMP vector supercomputer. Author

N92-22415# Technische Univ., Delft (Netherlands).
SEMANTIC DATA MODELING IN RELATIONAL ENVIRONMENTS Ph.D. Thesis
Johannes Hendrikus terBekke 1991 145 p
(ISBN-90-9004132-X; ETN-92-91164) Copyright Avail: NTIS HC/MF A07

A semantic data model is introduced and its viability and power in a number of examples are demonstrated. The examples also illustrate the applicability of semantic concepts in relational environments. Basic notions of data modeling and semantic concepts, operation and integrity are covered. ESA

N92-22416# Technische Univ., Delft (Netherlands).
PEL-RECURSIVE MOTION ESTIMATION FOR IMAGE CODING Ph.D. Thesis
Lilla Boroczky 1991 156 p Sponsored by Szechenyi Foundation
(ETN-92-91165) Avail: NTIS HC/MF A08

Pel-recursive motion estimation algorithms in an image coding framework are studied. The well performing Wiener based displacement estimation algorithm proposed by Biemond et al is investigated in detail. Several newly developed, generalized versions of the Wiener based motion estimator are introduced, which outperform the original algorithm. Further, some effective extensions are also proposed in order to improve the numerical stability and estimation performance of the original and the generalized algorithms. ESA

N92-22420 Politecnico di Milano (Italy). Dipartimento di Elettronica.
ALGRES: A RELATIONAL PROGRAMMING LANGUAGE FOR PROTOTYPING OF COMPLEX APPLICATIONS [ALGRES: UN LINGUAGGIO RELAZIONALE ESTESO PER LA PROTOTIPAZIONE DI APPLICAZIONI COMPLESSE]
F. Cacace and G. Lamperti (TXT Ingegneria Informatica S.p.A., Milan, Italy) 1991 23 p In ITALIAN; ENGLISH summary Sponsored in part by CNR
(Rept-91-045; ETN-92-91180) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

ALGRES is a relational programming language designed for rapid prototyping of applications which need complex data structuring and manipulating capabilities. The ALGRES programming environment is described, together with some applications to rapid prototyping in the database field. ESA

N92-22629*# Research Inst. for Computing and Information Systems, Houston, TX.
DISTRIBUTED SYSTEMS AND Ada Final Report
30 Jun. 1989 165 p Prepared in cooperation with Intermetrics, Inc., Houston, TX
(Contract NCC9-16; RICIS Proj. SE-28)
(NASA-CR-190174; NAS 1.26:190174) Avail: NTIS HC/MF A08 CSCL 09B

Viewgraphs of two briefings designed to provide information to the Software I and V Study Group to help complete the I and V study task are given. The information is taken from the areas of Ada real-time processing support, Ada run-time environments, Ada program construction, object oriented design, and Ada/-UNIX/POSIX interfaces. Also covered are the development, integration, and verification of Ada systems; fault tolerance and Ada; and Ada programming standards, techniques, and tools. Author

N92-22667*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
USER'S MANUAL FOR MacPASCO
S. H. Lucas (Analytical Services and Materials, Inc., Hampton, VA.) and R. C. Davis Feb. 1992 103 p
(NASA-TM-104122; NAS 1.15:104122) Avail: NTIS HC/MF A06 CSCL 09B

A user's manual is presented for MacPASCO, which is an interactive, graphic, preprocessor for panel design. MacPASCO creates input for PASCO, an existing computer code for structural analysis and sizing of longitudinally stiffened composite panels. MacPASCO provides a graphical user interface which simplifies the specification of panel geometry and reduces user input errors. The user draws the initial structural geometry and reduces user input errors. The user draws the initial structural geometry on the computer screen, then uses a combination of graphic and text inputs to: refine the structural geometry; specify information required for analysis such as panel load and boundary conditions; and define design variables and constraints for minimum mass optimization. Only the use of MacPASCO is described, since the use of PASCO has been documented elsewhere. Author

N92-22668# Technische Univ., Delft (Netherlands).
NATURAL LANGUAGE COMMUNICATION BETWEEN MAN AND MACHINE Ph.D. Thesis
Afra Maria Cunegondi vanRijn 1991 162 p Sponsored by SPIN/FLAIR
(ISBN-90-900-4111-7; ETN-92-91163) Copyright Avail: NTIS HC/MF A08

Topics in natural language processing are discussed. The main theoretical issues are knowledge representation in the form of a Conceptual Dependency Graph (CDG) and the handling of dialogue. Discussions in lexicon, language parsing, and language generation show how the CDG representation can be used for natural language processing. An application which influences the choice of CDGs to represent language is discussed. The project is concerned with the construction of a flexible assembly cell. The instruction interpreter and the dialogue system used for handling the input of additional information are described and evaluated. ESA

N92-23091*# Research Inst. for Computing and Information Systems, Houston, TX.
MICROCOMPUTER INTELLIGENCE FOR TECHNICAL TRAINING (MITT): THE EVOLUTION OF AN INTELLIGENT TUTORING SYSTEM Final Report
Jeffrey E. Norton, Bradley J. Wiederholt, and William B. Johnson Oct. 1990 27 p Prepared in cooperation with Galaxy Scientific Corp., Atlanta, GA
(Contract NCC9-16; RICIS Proj. ET-11)
(NASA-CR-190180; NAS 1.26:190180) Avail: NTIS HC/MF A03 CSCL 09B

Microcomputer Intelligence for Technical Training (MITT) uses Intelligent Tutoring System (OTS) technology to deliver diagnostic training in a variety of complex technical domains. Over the past six years, MITT technology has been used to develop training systems for nuclear power plant diesel generator diagnosis, Space Shuttle fuel cell diagnosis, and message processing diagnosis for the Minuteman missile. Presented here is an overview of the MITT system, describing the evolution of the MITT software and the benefits of using the MITT system. Author

N92-22328*# Systems Research Labs., Inc., San Antonio, TX.
STRUCTURED ANALYSIS AND MODELING OF COMPLEX SYSTEMS
David R. Strome and Mathieu A. Dalrymple *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 451-453 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09B

N92-22336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TRANSPORTABLE APPLICATIONS ENVIRONMENT (TAE) PLUS: A NASA TOOL USED TO DEVELOP AND MANAGE GRAPHICAL USER INTERFACES
Martha R. Szczur *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 508-513 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09B

N92-22337*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.
COMPUTER AIDED SYSTEMS HUMAN ENGINEERING: A HYPERMEDIA TOOL
Kenneth R. Boff, Donald L. Monk, and William J. Cody (Search Technology, Inc., Atlanta, GA.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 514-521 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 09B

N92-22468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HYBRID AUTOMATED RELIABILITY PREDICTOR INTEGRATED WORK STATION (HiREL)
Salvatore J. Bavuso *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 385-394 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

N92-22469*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
Ada AND THE RAPID DEVELOPMENT LIFECYCLE
Lloyd DeForrest and Lynn Gref *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 395-405 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

N92-22470*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ADVANCES IN KNOWLEDGE-BASED SOFTWARE ENGINEERING
Walt Truszkowski *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 406-414 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

N92-22471*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
REDUCING THE COMPLEXITY OF THE SOFTWARE DESIGN PROCESS WITH OBJECT-ORIENTED DESIGN
M. P. Schuler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 415-425 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

N92-22473*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A VECTOR-PRODUCT INFORMATION RETRIEVAL SYSTEM ADAPTED TO HETEROGENEOUS, DISTRIBUTED COMPUTING ENVIRONMENTS
Mark E. Rorvig *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 436-441 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

N92-22685*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
KNOWLEDGE-BASED AUTONOMOUS TEST ENGINEER (KATE)
Carrie L. Parrish and Barbara L. Brown *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 83-92 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22693*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CLIPS: AN EXPERT SYSTEM BUILDING TOOL
Gary Riley *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 149-158 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22708*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SOFTWARE REENGINEERING
Ernest M. Fridge, III *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 277-286 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22709*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COSTMODL: AN AUTOMATED SOFTWARE DEVELOPMENT COST ESTIMATION TOOL
George B. Roush *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 287-293 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22715*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMPASS: A GENERAL PURPOSE COMPUTER AIDED SCHEDULING TOOL
Mary Beth McMahon, Barry Fox (McDonnell-Douglas Space Systems Co., Houston, TX.), and Chris Culbert *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 352-357 (For primary document see N92-22676 13-99)
(Contract NAS9-17885)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22716*# National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.
ELAS: A POWERFUL, GENERAL PURPOSE IMAGE PROCESSING PACKAGE
David Walters and Douglas Rickman *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 361-365 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22717*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TRANSPORTABLE APPLICATIONS ENVIRONMENT (TAE) PLUS: A NASA TOOL FOR BUILDING AND MANAGING GRAPHICAL USER INTERFACES
Martha R. Szczur *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 366-376 Previously announced as N91-24048 and A92-17607 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22718*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INSTRUMENTATION, PERFORMANCE VISUALIZATION, AND DEBUGGING TOOLS FOR MULTIPROCESSORS
Jerry C. Yan, Charles E. Fineman (Sterling Federal Systems, Inc., Moffett Field, CA.), and Philip J. Hontalas *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 377-385 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-22125# Technische Univ., Berlin (Germany, F.R.). Fachbereich Informatik.
CONCEPTS, TECHNIQUES, AND PERSPECTIVES OF BTX (VIDOTEX) SYSTEMS, IN THE FRAMEWORK OF A MODERN COMMUNICATION TECHNOLOGY Ph.D. Thesis [KONZEPTE, TECHNIKEN UND PERSPEKTIVEN VON BTX-(VIDEOTEX) SYSTEMEN IM RAHMEN MODERNER KOMMUNIKATIONSTECHNOLOGIE]
Stefan Jiranek 1991 232 p In GERMAN
(ETN-92-91155) Avail: NTIS HC/MF A11

Btx is described as a modern information dialog and data transfer service, which is designed as a communication service for a very great number of subscribers. Only a normal telephone and a modem are necessary for the communication, which dials the nearest telephone exchange in telephone local range. The historical development is emphasized, and the concepts are represented, using national and international standards. The necessary communication networks are described. Examples are presented for the most important Btx application systems in external computers. ESA

N92-22171# Mitre Corp., Bedford, MA.
THE CASCADING PROBLEM
Jonathan K. Millen Dec. 1991 28 p
(Contract DAAB07-91-C-N751)
(AD-A244577; M91-87) Avail: NTIS HC/MF A03 CSCL 12/8

When a trusted computer system is connected to a network, there are new risks to consider, risks to the network as well as to the computer system. Each party to the connection wishes to ensure that the sensitive data it protects will continue to be adequately protected when it is exported across the connection. Obviously, the system receiving the exported information should be capable of protecting it; this is a local risk factor. It is less obvious that there are also global risks, which depend on the topology of the network. The cascading problem is one of those global risks. This paper characterizes the problem and summarizes what is known about detecting it analytically. It includes a matrix algorithm reported previously only in less accessible references, and discusses the assumptions and rationale behind cascading analysis. Cascading is a concern in networks where dissemination of information is limited on the basis of a sensitivity label and some less standardized need-to-know controls. The cascading problem is concerned with access control based on the sensitivity label. Respecting need-to-know restrictions is an important consideration in network security policy, but it has an impact on the cascading problem only on the extent that it influences the topology of the network. Sensitivity label restrictions in a multilevel network are handled by assigning each subsystem an accreditation range, defining the set of sensitivity levels that a subsystem is trusted to segregate, and label accurately for export over network links. GRA

N92-22223 Politecnico di Milano (Italy). Dipartimento di Elettronica.
COST FUNCTIONS DRIVEN MULTIPROCESSOR SCHEDULING
Kim Portman 1991 21 p

(Grant Finn-Acad-8001056)
(Rept-91-050; ETN-92-91183) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The use of cost functions for deriving optimum processor allocation strategies in multiprogrammed multiprocessor systems is described. A class of cost functions is derived from traditional performance measures and performance indices. A simple relation between these cost functions is proved, and their influence under different scheduling disciplines is shown. These theoretical results are demonstrated using mathematical modeling results and experiment program runs. ESA

N92-22224 Politecnico di Milano (Italy). Dipartimento di Elettronica.
A SURVEY OF PARALLEL EXECUTION STRATEGIES FOR TRANSITIVE CLOSURE AND LOGIC PROGRAMS
Filippo Cacace, Stefano Ceri, and Maurice A. W. Houtsma (Universiteit Twente, Enschede, Netherlands) 3 Oct. 1991 58 p Sponsored in part by CNR and Royal Netherlands Academy of Arts and Sciences
(Rept-91-051; ETN-92-91184) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The approaches to parallel execution of recursive queries discussed in recent literature are surveyed. It is observed that research on parallel execution of recursive queries is separated into two distinct sub-areas, one focused on the transitive closure of relational algebra expressions, the other one focused on optimization of more general datalog queries. The relationship between the transitive closure of expressions in relational algebra and datalog is analyzed and then sequential methods for evaluating transitive closure is addressed. The parallelization of these methods is addressed by introducing a graphic formalism for describing parallel executions, and by discussing various forms of parallelization. Data fragmentation plays an important role; hash based and semantic fragmentation are described. A quantitative analysis comparing the methods is provided and the relevance of data fragmentation from a quantitative viewpoint is discussed. Datalog queries, and present general methods for parallel rule execution are considered; the similarities betweeen these methods and the algebraic methods reviewed previously are recognized when the former are applied to simple datalog queries. ESA

N92-22285*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FAULT TOLERANCE OF ARTIFICIAL NEURAL NETWORKS WITH APPLICATIONS IN CRITICAL SYSTEMS
Peter W. Protzel, Daniel L. Palumbo, and Michael K. Arras (Institute for Computer Applications in Science and Engineering, Hampton, VA.) Apr. 1992 50 p
(NASA-TP-3187; L-16969; NAS 1.60:3187) Avail: NTIS HC/MF A03 CSCL 09B

This paper investigates the fault tolerance characteristics of time continuous recurrent artificial neural networks (ANN) that can be used to solve optimization problems. The principle of operations and performance of these networks are first illustrated by using well-known model problems like the traveling salesman problem and the assignment problem. The ANNs are then subjected to 13 simultaneous 'stuck at 1' or 'stuck at 0' faults for network sizes of up to 900 'neurons'. The effects of these faults is demonstrated and the cause for the observed fault tolerance is discussed. An application is presented in which a network performs a critical task for a real-time distributed processing system by generating new task allocations during the reconfiguration of the system. The performance degradation of the ANN under the presence of faults is investigated by large-scale simulations, and the potential benefits of delegating a critical task to a fault tolerant network are discussed. Author

N92-22303# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
WORKSTATION NETWORKING USING ADVANCED DATA LINK CONTROLLERS M.S. Thesis
Paul Evans (Royal Australian Air Force, Edinburgh.) 1990 125 p Prepared in cooperation with Royal Air Force Coll., Cranwell, England
(ETN-92-91055) Copyright Avail: NTIS HC/MF A06

Data link controlling and methods of interconnecting microprocessor workstations in a network are investigated. Aims, scope, and approach to the project, which aimed to design software and hardware for the use of a High Level Data Link Control (HDLC), are given. Different network topologies and architectures are described and levels of protocol are investigated. Bit oriented protocols and byte controlled protocols are detailed. HDLC is described in depth. The circuitry of the printed circuit board comprising the hardware design is described, covering address decoding, clock signal generation, switch settings, circuit logic, and including schematic diagrams and printed circuit board masks. Requirements and capabilties of the designed software are detailed. Two programs, one for the primary controller and one for the secondary stations, are required. A user manual for software and hardware operation is provided. ESA

N92-22320*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FORMAL DESIGN AND VERIFICATION OF A RELIABLE COMPUTING PLATFORM FOR REAL-TIME CONTROL. PHASE 2: RESULTS
Ricky W. Butler and Ben L. DiVito (Vigyan Research Associates, Inc., Hampton, VA.) Jan. 1992 161 p
(NASA-TM-104196; NAS 1.15:104196) Avail: NTIS HC/MF A08 CSCL 09B

The design and formal verification of the Reliable Computing Platform (RCP), a fault tolerant computing system for digital flight control applications is presented. The RCP uses N-Multiply Redundant (NMR) style redundancy to mask faults and internal majority voting to flush the effects of transient faults. The system is formally specified and verified using the Ehdm verification system. A major goal of this work is to provide the system with significant capability to withstand the effects of High Intensity Radiated Fields (HIRF). Author

N92-22422 Politecnico di Milano (Italy). Dipartimento di Elettronica.
COMPARISON BETWEEN SIMD AND MIMD APPROACH IN THE CONTEXT OF IMAGE SYNTHESIS ALGORITHMS [COMPARAZIONE TRA GLI APPROCCI SIMD E MIMD AL PROBLEMA DELLA PARALLELIZZAZIONE DEGLI ALGORITMI PER LA SINTESI DI IMMAGINI]
Cristiano Sacchi Oct. 1991 19 p In ITALIAN; ENGLISH summary
(Rept-91-049; ETN-92-91182) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A comparison between Single Instruction Multiple Data stream (SIMD) and Multiple Instruction Multiple Data stream (MIMD) parallel architectures in the context of image processing is presented. A simple ray casting algorithm was implemented to compare the two approaches. The results are in favor of MIMD architecture as a better platform for image synthesis algorithms. ESA

N92-22674 Politecnico di Milano (Italy). Dipartimento di Elettronica.
PROTOZOA-LIKE ADAPTING BUGS
Fabio deLuigi and Vittorio Maniezzo Sep. 1991 15 p
(Rept-91-043; ETN-92-91178) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Distributed approaches are becoming ubiquitous in computer science theory and applications; distributed simulations in particular promise to be effective both in terms of efficient exploitation of parallel computer hardware architectures and of ease of identification of several kinds of nonlinear system. Adaptation through self-organization on the other hand has proven one of the most fruitful topics of cross fertilization between biology and computer science. A model for distributed simulation of adapting bugs is proposed, encompassing features taken from genetic algorithms, from neural networks, and from cellular automata. The characteristics of the simulated bugs are taken from the biology

of protozoa, thus bringing the underlying genetic algorithm back toward its inspiring biological metaphor. Emphasis is put on intrinsic adaptation, thus on the usefulness of an explicit numerical fitness function for the problem tackled, and in the minimality of the model proposed. ESA

N92-22711*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE USE OF HYPERMEDIA TO INCREASE THE PRODUCTIVITY OF SOFTWARE DEVELOPMENT TEAMS
L. Stephen Coles *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 301-307 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22713*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HIGHER-ORDER NEURAL NETWORK SOFTWARE FOR DISTORTION INVARIANT OBJECT RECOGNITION
Max B. Reid and Lilly Spirkovska *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 325-334 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-22103# Duke Univ., Durham, NC. Dept. of Computer Science.
INFERENCE AND DECISION MECHANISMS IN ARTIFICIAL INTELLIGENCE Final Report, 1988 - 1991
D. W. Loveland and A. W. Biermann Sep. 1991 18 p
(Contract DAAL03-88-K-0082)
(AD-A244564; ARO-25195.11-MA-AI) Avail: NTIS HC/MF A03 CSCL 12/9

This grant impacted several projects undertaken by investigators. The METEOR theorem proving project focussed on a parallel implementation of the Model Elimination proof procedure, but discovered that the sequential version is also very powerful. The Near-Horn Prolog addresses disjunctive logic programming, which extends Horn clause logic (Prolog) by allowing clauses with multiple positive literals. The lambda-Prolog project investigates foundational and implementation related aspects of a Prolog extension that incorporates higher-order logic terms and new search primitives into the Horn clause logic framework. The resulting language has been shown to be useful for prototyping new inference-oriented software. The final project is really several projects in learning; foundational, utilizing connectionism, and learning real-time programs. GRA

N92-22123# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
NEURAL NETWORKS FOR NON-LINEAR DYNAMIC SYSTEM MODELLING AND IDENTIFICATION
S. Chen and S. A. Billings Sep. 1991 46 p
(RR-436; ETN-92-91092) Avail: NTIS HC/MF A03

Many real world systems exhibit complex nonlinear characteristics and cannot be treated satisfactorily using linear systems theory. A neural network which has the ability to learn sophisticated nonlinear relationships provides an ideal means of modeling complicated nonlinear systems. The issues related to the identification of nonlinear discrete time dynamic systems using neural networks are addressed. The network architectures, namely the multilayer perceptron, the radial basis function network, and the functional link network are presented and several learning or identification algorithms are derived. Advantages and disadvantages of these structures are discussed and illustrated using simulated and real data. Particular attention is given to the connections between existing techniques for nonlinear stystems identification and some aspects of neural network methodology; this demonstrated that certain techniques employed in the neural network context have long been developed by the control engineering community. ESA

N92-22221# Argonne National Lab., IL.
AUTOMATED REASONING AND ENUMERATIVE SEARCH WITH A PPLICATIONS TO MATHEMATICS
Jian Zhang (Academia Sinica, Beijing, China) and L. Wos 1991 4 p Presented at the International Conference for Young Computer Scientists, Beijing (China), 18-20 Jul. 1991
(Contract W-31-109-eng-38)
(DE92-006982; ANL/CP-75127; CONF-9107203-1) Avail: NTIS HC/MF A01

Each day, greater numbers of mathematical problems are being solved with the aid of computers. In this paper, we examine the applications of reasoning and search programs to mathematics. It is also shown that the combination of these two techniques can solve mathematical problems more effectively. DOE

N92-22282*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE DOUBLE UNIVERSAL JOINT WRIST ON A MANIPULATOR: SOLUTION OF INVERSE POSITION KINEMATICS AND SINGULARITY ANALYSIS
Robert L. Williams, III Mar. 1992 40 p
(NASA-TM-104212; NAS 1.15:104212) Avail: NTIS HC/MF A03 CSCL 09B

This paper presents three methods to solve the inverse pcsition kinematics position problem of the double universal joint attached to a manipulator: (1) an analytical solution for two specific cases; (2) an approximate closed form solution based on ignoring the wrist offset; and (3) an iterative method which repeats closed form position and orientation calculations until the solution is achieved. Several manipulators are used to demonstrate the solution methods: cartesian, cylindrical, spherical, and an anthropomorphic articulated arm, based on the Flight Telerobotic Servicer (FTS) arm. A singularity analysis is presented for the double universal joint wrist attached to the above manipulator arms. While the double universal joint wrist standing alone is singularity-free in orientation, the singularity analysis indicates the presence of coupled position/orientation singularities of the spherical and articulated manipulators with the wrist. The cartesian and cylindrical manipulators with the double universal joint wrist were found to be singularity-free. The methods of this paper can be implemented in a real-time controller for manipulators with the double universal joint wrist. Such mechanically dextrous systems could be used in telerobotic and industrial applications, but further work is required to avoid the singularities. Author

N92-22419 Politecnico di Milano (Italy). Dipartimento di Elettronica.
GENETICS-BASED MACHINE LEARNING AND BEHAVIOR-BASED ROBOTICS: A NEW SYNTHESIS
Marco Dorigo and Uwe Schnepf (Gesellschaft fuer Mathematik und Datenverarbeitung, Saint Augustin, Germany, F.R.) Feb. 1991 23 p
(Rept-91-044; ETN-92-91179) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Intelligent robots should be able to use sensor information to learn how to behave in a changing environment. As environmental complexity grows, the learning task becomes more and more difficult. This problem is faced using an architecture based on learning classifier systems and on the structural properties of animal behavioral organization, as proposed by ethologists. After a description of the learning technique used and of the organizational structure proposed, experiments that show how behavior acquisition can be achieved are presented. A simulated robot learns to follow a light and to avoid hot dangerous sources. While these two simple

behaviors are independently learned, coordination is attained by means of a learning coordination mechanism. Again this capacity is demonstrated by performing a number of experiments. ESA

N92-22671 Politecnico di Milano (Italy). Dipartimento di Elettronica.
UNCERTAINTY COMPONENTS: ISSUES AND A PROPOSAL FOR THEIR INTEGRATED MANAGEMENT IN EXPERT SYSTEMS
Andrea Bonarini Aug. 1991 13 p Presented at World Congress on Expert Systems, Orlando, FL, 1991 Submitted for publication (Rept-91-035; ETN-92-91175) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The name 'uncertainty' has been often used in artificial intelligence to refer to features like 'vagueness', 'questionability', 'ambiguity', 'unreliability'. A contribution to the definition of the different concepts underlying the term 'uncertainty' is given. CUMa (Components of Uncertainty Manager), an environment enabling the definition of different uncertainty components, each one associated to a measure and a set of laws to combine its values is presented. Each uncertainty component has a measure that can be defined in terms of different quantities, such as: real numbers, linguistic labels, fuzzy numbers, or pairs of each of the previous quantities. The expert system designer can use CUMa to assemble the Uncertainty Manager most suitable for an application, considering only some of the already defined uncertainty components, modifying their definitions or defining new ones. In CUMa, knowledge about uncertainty is associated to propositions connected in a network by inferential links. Each component is propagated in the network independently, but the production of a global measure of the uncertainty of each node is possible. The status of the network can be monitored either concentrating on the signal features, or by considering aggregations of them. Cyclic paths are also managed by the system. CUMa can be usefully and easily integrated in expert systems architectures. ESA

N92-22672 Politecnico di Milano (Italy). Dipartimento di Elettronica.
OPPORTUNISTIC MULTIMODEL-BASED DIAGNOSIS: USING ALL THE KNOWLEDGE WE HAVE
Andrea Bonarini and Piera Sassaroli Aug. 1991 15 p (Rept-91-036; ETN-92-91176) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Knowledge acquisition and knowledge organization are important bottlenecks in the development of knowledge based systems. Second generation expert systems try to reduce the dependency from experts introducing models of the domain of application, instead of models of expert's experience. In industrial applications, different types of models are available, but rarely a complete model of a complex device is available. Therefore, the problem of knowledge incompleteness has to be faced explicitly. A framework to organize domain knowledge about artifacts in models is defined along three dimensions: level of abstraction, uncertainty and epistemological type (teleology, process, function, structure). Predefined primitives enables quick and reliable model acquisition. The available heuristic knowledge is integrated with this model based description. The modeler/diagnostician can provide a measure of the subjective confidence in each knowledge element. Moreover, all the knowledge is represented using (possibly qualitative relationships among variables and (possibly approximated) values. Our system uses this incomplete, uncertain and approximate knowledge to diagnose a complex artifact (an industrial plant). It navigates oportunistically through an arbitrary set of models to reach a predefined diagnosis goal. The navigation is guided by diagnostic meta knowledge, ranking all the possible choices according to their tendency to push towards the goal state. Different goal states may be defined for different types of diagnosis. ESA

N92-22474*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AUTOCLASS: AN AUTOMATIC CLASSIFICATION SYSTEM
John Stutz, Peter Cheeseman, and Robin Hanson (Sterling Software, Moffett Field, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 442-450 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

N92-22694*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FUZZY LOGIC APPLICATIONS TO EXPERT SYSTEMS AND CONTROL
Robert N. Lea and Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 159-168 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22695*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NEURAL NETWORK TECHNOLOGIES
James A. Villarreal *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 169-173 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22696*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FROM BIOLOGICAL NEURAL NETWORKS TO THINKING MACHINES: TRANSITIONING BIOLOGICAL ORGANIZATIONAL PRINCIPLES TO COMPUTER TECHNOLOGY
Muriel D. Ross *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 174-180 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

N92-22714*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CONSTRAINT-BASED SCHEDULING
Monte Zweben *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 335-351 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-22128# Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France).
SCHROEDINGER FUNCTIONAL EQUATION FOR YANG-MILLS THEORY
J. N. Islam Aug. 1991 33 p Prepared in cooperation with Chittagong Univ., Bangladesh; International Centre for Theoretical Physics, Trieste, Italy; and Cambridge Univ., England (PB92-115641; IHES/P/91/53) Avail: NTIS HC/MF A03 CSCL 12A

A generalization to 3 + 1 dimensions of a conjecture in 2 + 1 dimensions, made by Feynman, is considered for the ground state of a set of vector bosons interacting through a Yang-Mills type Lagrangian. It was shown that the conjectured wave function satisfies the gauge constraint and Schroedinger equations to second order in the fields. It is presently shown that a slightly generalized form of the conjecture satisfies the gauge constraint equation to third order in the fields. The formalism is developed for tackling the Schroedinger equation for the problem in the third order. The formalism may be of use in a wider context. The conjectured wave function is shown to satisfy the Schroedinger equation to third order. The significance of these results and their relation to some other problems is discussed. GRA

N92-22230*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN INVESTIGATION OF DTNS2D FOR USE AS AN INCOMPRESSIBLE TURBULENCE MODELLING TEST-BED
Christopher J. Steffen, Jr. Mar. 1992 18 p
(NASA-TM-105593; ICOMP-92-07; CMOTT-92-04; E-6924; NAS 1.15:105593) Avail: NTIS HC/MF A03 CSCL 12A

This paper documents an investigation of a two dimensional, incompressible Navier-Stokes solver for use as a test-bed for turbulence modelling. DTNS2D is the code under consideration for use at the Center for Modelling of Turbulence and Transition (CMOTT). This code was created by Gorski at the David Taylor Research Center and incorporates the pseudo compressibility method. Two laminar benchmark flows are used to measure the performance and implementation of the method. The classical solution of the Blasius boundary layer is used for validating the flat plate flow, while experimental data is incorporated in the validation of backward facing step flow. Velocity profiles, convergence histories, and reattachment lengths are used to quantify these calculations. The organization and adaptability of the code are also examined in light of the role as a numerical test-bed. Author

N92-22413# Technische Univ., Delft (Netherlands).
THE STRUCTURE OF TRAJECTORIES Ph.D. Thesis
Robbert Johan Fokkink 1991 110 p
(ETN-92-91141) Copyright Avail: NTIS HC/MF A06

A study motivated by the following problem is presented: let pi(sub alpha) and pi(sub beta) be irrational flows on the Torus T(2) and let Gamma(sub alpha), Gamma(sub beta) be orbits in (T(2), pi(sub alpha)) and (T(2), pi(sub beta)) respectively; for which irrational numbers alpha and beta are Gamma(sub alpha) and Gamma(sub beta) homeomorphic (referred to as Aarts' problem). Related problems from topological dynamics and continuum theory are discussed. The basic properties of matchbox manifolds are also studied and are applied to some specific examples. The topological classification of single trajectories in flows is addressed. It is proved that trajectories can be embedded in the suspension of two sided shift in the Cantor set. Inspired by Aarts' problem on trajectories in irrational flows, the type of trajectories that can be embedded in a compact surface is studied. ESA

N92-22606 Cornell Univ., Ithaca, NY.
SHAPE DESIGN SENSITIVITY ANALYSIS BY THE BOUNDARY ELEMENT METHOD Ph.D. Thesis
Qing Zhang 1991 165 p
Avail: Univ. Microfilms Order No. DA9204058

Shape design sensitivity analysis formulations and numerical results are presented for calculation of design sensitivity coefficients (DSCs) for linear (elasticity) and nonlinear (both material and geometric) problems in solid mechanics. Design sensitivity coefficients refer to rates of change of response variables such as displacements or stresses in a deforming solid body, with respect to parameters that control the initial, undeformed shape of the body. In nonlinear problems, these DSCs are history dependent. The direct differentiation approach (DDA) of the relevant derivative boundary element method (DBEM) formulation is used to obtain the design sensitivity coefficients. Modeling of sharp corners on the boundary of a body is given special attention. Numerical results are presented for illustrative examples. The formulation for sensitivity analysis, for nonlinear problems, is written in the current frame. Updating of the geometry must be carried out, as required, during a simulation. Shape design variables, however, are only defined in the original undeformed configuration and design sensitivities are obtained with respect to changes in these design variables. Dissert. Abstr.

N92-22627*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ESSENTIALLY NONOSCILLATORY POSTPROCESSING FILTERING METHODS Final Report
F. Lafon and S. Osher (California Univ., Los Angeles.) Jan. 1992 24 p Submitted for publication
(Contracts NAS1-18605; N00014-86-K-0691; NSF DMS-88-11863) (NASA-CR-189610; NAS 1.26:189610; ICASE-92-5) Avail: NTIS HC/MF A03 CSCL 12A

High order accurate centered flux approximations used in the computation of numerical solutions to nonlinear partial differential equations produce large oscillations in regions of sharp transitions. Here, we present a new class of filtering methods denoted by Essentially Nonoscillatory Least Squares (ENOLS), which constructs an upgraded filtered solution that is close to the physically correct weak solution of the original evolution equation. Our method relies on the evaluation of a least squares polynomial approximation to oscillatory data using a set of points which is determined via the ENO network. Numerical results are given in one and two space dimensions for both scalar and systems of hyperbolic conservation laws. Computational running time, efficiency, and robustness of method are illustrated in various examples such as Riemann initial data for both Burgers' and Euler's equations of gas dynamics. In all standard cases, the filtered solution appears to converge numerically to the correct solution of the original problem. Some interesting results based on nonstandard central difference schemes, which exactly preserve entropy, and have been recently shown generally not to be weakly convergent to a solution of the conservation law, are also obtained using our filters. Author

N92-22493*# Akron Univ., OH. Dept. of Electrical Engineering
APPROXIMATE TRUNCATED BALANCED REALIZATIONS FOR INFINITE DIMENSIONAL SYSTEMS
Tom T. Hartley and J. Alex DeAbreu-Garcia *In its* Improved Large Perturbation Propulsion Models for Control System Design (1988-1989) and Large Perturbation Models of High Velocity Propulsion Systems (1989-1990) and Reduced Order Propulsion Models for Control System Design (1990-1991) Dec. 1991 14 p (For primary document see N92-22491 13-34)
(Grant NAG3-904)
Avail: NTIS HC/MF A05 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-22122# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
PARAMETER ESTIMATION FOR STOCHASTIC NONLINEAR RATIONAL MODELS
Q. M. Zhu and S. A. Billings 19 Sep. 1991 34 p
(Grant SERC-GR/F2417-17)
(RR-435; ETN-92-91091) Avail: NTIS HC/MF A03

A general orthogonal parameter estimation algorithm is derived to estimate both the structure and the parameters for a wide range of stochastic nonlinear systems which can be described by a nonlinear rational model. Simulation studies are included to demonstrate the performance of the algorithm. ESA

N92-23108# Oak Ridge National Lab., TN.
PARALLEL IMPLEMENTATION OF THE MONTE CARLO TRANSPORT CODE EGS4 ON THE HYPERCUBE
B. L. Kirk, Y. Y. Azmy, T. A. Gabriel, and C. Y. Fu 1991 15 p Proposed for presentation at the Meeting on New Horizons in Radiation Protection and Shielding, Pasco, WA, 26 Apr. - 1 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-006593; CONF-920431-10) Avail: NTIS HC/MF A03

Monte Carlo transport codes are commonly used in the study of particle interactions. The CALOR89 code system is a combination of several Monte Carlo transport and analysis programs. In order to produce good results, a typical Monte Carlo run will have to produce many particle histories. On a single processor computer, the transport calculation can take a huge amount of time. However, if the transport of particles were divided

among several processors in a multiprocessor machine, the time can be drastically reduced. DOE

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-22231 Politecnico di Milano (Italy). Dipartimento di Elettronica.
PSICO TODAY
Sergio Bittanti 1991 14 p Sponsored by Italian Ministry of University and Scientific Research and CNR
(Rept-91-055; ETN-92-91186) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A list of selected papers on the topic of PSICO (Periodic Systems Identification, Control, and Optimization) is given, and the subject is briefly introduced. The list is organized in topics of major interest: structural properties and canonical decomposition; periodic Riccati equation and periodic Lyapunov equation; identification, signal processing, and time series analysis; optimal control; stabilization, regulation, pole assignment, and all that; periodic versus time invariant and time varying controllers; and multirate digital control. ESA

N92-22251# Naval Postgraduate School, Monterey, CA.
THE SHORTEST PATH PROBLEM IN THE PLANE WITH OBSTACLES: A GRAPH MODELING APPROACH TO PRODUCING FINITE SEARCH LISTS OF HOMOTOPY CLASSES M.S. Thesis
Kevin D. Jenkins Jun. 1991 125 p
(AD-A245059) Avail: NTIS HC/MF A06 CSCL 12/2

The problem of finding the shortest path between two points in a plane containing obstacles is considered. The set of such paths is uncountably infinite, making an exhaustive search impossible. This difficulty is overcome by reducing the size of the search space. The search is first restricted to a countably infinite set by focusing attention on the set of homotopy classes. By applying simple optimality principles, a finite list of such classes is obtained whose union contains the shortest path. This process of simplification is accomplished by modeling the topology of the region with a graph. Optimality principles come into play during a graph traversal which is used to produce the finite search list. In addition, a computational investigation of two methods by which homotopy classes can be named is discussed, and properties of the graph models are investigated. The thesis of CPT Andre M. Cuerington, U.S. Army, calculates the actual shortest path using the search list produced here. GRA

N92-22643*# Boeing Advanced Systems Co., Seattle, WA.
DESIGN OF AN INTEGRATED AIRFRAME/PROPULSION CONTROL SYSTEM ARCHITECTURE
Gerald C. Cohen, C. William Lee, and Michael J. Strickland Mar. 1990 556 p
(Contract NAS1-18099)
(NASA-CR-182004; NAS 1.26:182004) Avail: NTIS HC/MF A24 CSCL 12B

The design of an integrated airframe/propulsion control system architecture is described. The design is based on a prevalidation methodology that used both reliability and performance tools. An account is given of the motivation for the final design and problems associated with both reliability and performance modeling. The appendices contain a listing of the code for both the reliability and performance model used in the design. Author

N92-22644*# Boeing Advanced Systems Co., Seattle, WA.
DESIGN OF AN INTEGRATED AIRFRAME/PROPULSION CONTROL SYSTEM ARCHITECTURE Final Report
Gerald C. Cohen, C. William Lee, Michael J. Strickland, and Thomas C. Torkelson Mar. 1990 253 p Prepared for Draper (Charles Stark) Lab., Inc., Cambridge, MA
(Contract NAS1-18099)
(NASA-CR-182007; NAS 1.26:182007) Avail: NTIS HC/MF A12 CSCL 12B

The design of an integrated airframe/propulsion control system architecture is described. The design is based on a prevalidation methodology that uses both reliability and performance. A detailed account is given for the testing associated with a subset of the architecture and concludes with general observations of applying the methodology to the architecture. Author

N92-22673 Politecnico di Milano (Italy). Dipartimento di Elettronica.
STATE AND TIME GRANULARITY IN SYSTEM DESCRIPTION: AN EXAMPLE
Fabio A. Schreiber Sep. 1991 11 p
(Rept-91-040; ETN-92-91177) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

By a simple, but realistic example, which can be extended to other application domains such as nuclear power plants or the game of chess, it is shown that the description tools for complex systems must be adapted to the desired level of granularity, and that the different levels can be formally related to each other. In an Air Traffic Control (ATC) radar system, a change in the state value at the lower level, i.e., airplane position, results in an event which, in turn, possibly triggers a state change at the upper level, i.e., the learning of the radar snapshot. This shows that not only the duality between events and state change can be fruitful for modeling complex systems, but also that the concept of state evaluation is consistent with such a model. A figure synthetically shows the main steps to the description transformation. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-22129# Electro Magnetic Applications, Inc., Newton, MA.
INFLUENCE OF PULSED MAGNETIC FIELDS ON UNIAXIAL STRESS OF FILMS Final Report, 15 Mar. - 14 Sep. 1991
C. Vittoria 11 Oct. 1991 37 p
(Contract DAAL03-91-C-0017)
(AD-A244634; ARO-28417.2-MS-SBI) Avail: NTIS HC/MF A03 CSCL 20/3

We have developed experimental pulsed field techniques by which stress is considerably reduced in films of Fe80B15Si5. One technique involves the application of a magnetic field of 500 Oe along the hard axis and maintaining the annealing temperature at 275 C. The other technique involves rotation of the film in the presence of the field. We model the reduction in stress in terms of a reduction of defects induced by gas inclusions during film preparation. Our estimate of the stress reduction is in reasonable agreement with other estimates deduced from extended x-ray absorption fine structure (EXAFS) studies. Our studies suggest a systematic experimental technique by which the magnetic anisotropy field can be tailored in a film. GRA

N92-22312# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: PHYSICS AND MATHEMATICS
16 Mar. 1992 47 p Transl. into ENGLISH from various Russian

articles
(JPRS-UPM-92-002) Avail: NTIS HC/MF A03

A bibliography is given of Central Eurasian research in physics and mathematics. Topics covered include acoustics, crystals, laser glasses, semiconductors, differential equations, theoretical physics, thermodynamics, superconductivity, plasma physics, optics, spectroscopy, nuclear physics, lasers, and fluid dynamics. Author

N92-22394# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CENTRAL EURASIA: PHYSICS AND MATHEMATICS
15 Jan. 1992 34 p Transl. into ENGLISH from various Russian articles
(JPRS-UPM-92-001) Avail: NTIS HC/MF A03

A bibliography of Central Eurasian research in physics and mathematics is given. Topics covered include acoustics, crystals, laser glasses, semiconductors, lasers, nuclear physics, optics, spectroscopy, plasma physics, superconductivity, and thermodynamics. Author

N92-22447*# Army Electronics Technology and Devices Lab., Fort Monmouth, NJ.
PERMANENT MAGNET DESIGN METHODOLOGY
Herbert A. Leupold *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 203-214 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20C

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution*.

N92-22155# Swedish Inst. for Materials Testing, Boras.
MEASUREMENTS OF SOUND REDUCTION INDEX WITH INTENSITY TECHNIQUE: NORDTEST PROJECT 746-88
H. G. Jonasson 1991 40 p
(PB92-122704; SP-RAPP-1991:23; ISBN-91-7848-280-1) Avail: NTIS HC/MF A03 CSCL 20A

The sound intensity technique has been tested on sound insulation measurements under laboratory conditions. It is shown that the agreement with traditional measurements of the sound reduction index is excellent. If the Waterhouse correction is applied in the receiving room, the weighted sound reduction index R(w) is overestimated by about 0.6 dB with a standard deviation of 1.0 dB. Without the correction, there is a small underestimate. A Nordtest method is proposed. In this method the sound intensity is determined by scanning a closed surface on the receiving side of the test specimen. At least two scans with different scanning patterns shall be carried out and the maximum difference between these two scans must not exceed 1.0 dB for any frequency band. The field indicator (the difference between the sound pressure level and the sound intensity level averaged over the measurement surface) must not exceed 10 dB and 6 dB for a test specimen which is sound reflecting and sound absorbing respectively on the receiving side. The Waterhouse correction shall be applied in the receiving room when comparing with traditional measurements. About 30 different measurements have been carried out in 3 different laboratories to get an estimate of the precision of the intensity method when comparing with the traditional measurement technique. In addition, measurements illustrating the influence of different parameters such as measurement distance, microphone spacing and measurement environment are described. Author

N92-22212*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CAPABILITIES OF THE THERMAL ACOUSTIC FATIGUE APPARATUS
S. A. Clevenson and E. F. Daniels Feb. 1992 40 p
(NASA-TM-104106; NAS 1.15:104106) Avail: NTIS HC/MF A03 CSCL 20A

The Thermal Acoustic Fatigue Apparatus (TAFA) is a facility for applying intense noise and heat to small test panels. Modifications to TAFA have increased the heating capability to 44 BTU/(ft.-sec.), making it possible to heat test panels to 2000 F and concurrently apply 168 dB of noise. Results of acoustic and thermal surveys are shown. Two test items, a 0.09 in. steel panel and an insulated panel, were used in the thermal survey. Author

N92-22241# Southampton Univ. (England). Audiology and Human Effects Group.
RISK TO HEARING FROM OVERFLIGHT NOISE OF MILITARY AIRCRAFT
B. W. Lawton and D. W. Robinson May 1991 56 p Sponsored by Ministry of Defence
(ISVR-TR-194; ETN-92-91197) Avail: NTIS HC/MF A04

The maximum level of aircraft noise to which the ear can be exposed without significant permanent noise induced hearing loss was investigated. A systematic database search is described. This search failed to reveal any published reports of permanent hearing threshold shift due to aircraft noise. However, some evidence exists that a small amount of temporary threshold shift may be induced by noise at levels in the region of 125 dB(A), which would nevertheless be without permanent effect. By characterizing overflight noise by its total exposure value (taking into account overflight duration), comparisons are made with existing damage risk criteria. Predictions of permanent threshold shift, using established relationships, suggest that there is no credible risk to hearing even for long term repeated exposures on the basis of several events per day at 125 dB(A). The nature of the relationship between noise exposure and permanent threshold shift, as it relates to the most susceptible fraction of an exposed population, inhibits the specification of a unique level which would guarantee total freedom from noise induced hearing loss in every individual. However, there appears to be a practical margin of safety in the case of aircraft noise producing a maximum level of 125 dB(A) during the overflight. The conclusion rests upon experimental evidence of the course of noise level versus time, typical of military aircraft overflights. Taking the margin of safety into account, recommendations are made which, while suggesting that the existing criterion value be maintained, offer guidance on its interpretation and practical implementation. ESA

N92-22965# Southampton Univ. (England). Inst. of Sound and Vibration Research.
ANNOYANCE DUE TO DISCRETE TONES IN BROADBAND BACKGROUND NOISE. PART 1: EXPERIMENTS
D. W. Robinson and P. Wright Nov. 1991 73 p
(ISVR-TR-201-Pt-1) Avail: NTIS HC/MF A04

Three experiments are described in which subjects judged the annoyance of various stimuli on a scale of 0 to 9. The stimuli comprised three broadcast noises, presented at various levels from 20 to 55 dB(A), to which pure tone were added at four levels above the respective masked threshold ranging from 5 to 26 dB sensation level; the broadcast noises were also presented on their own as a baseline for interpreting the annoyance judgements on the combination stimuli. For each combination, the effect of the tone was determined as a 'penalty', equal to the increase in level of the broadcast noise component on its own required to elicit the same annoyance as the combination. The tests were conducted in several sessions in anechoic binaural listening conditions with the exception of one series carried out in a simulated domestic living room; the change in environment was not found to influence the results. The tone penalty was found to increase nearly linearly with sensation level of the tone, and also to increase with tone frequency over the range 0.15 to 4.8 kilo-Hz, save for a local minimum at 1.2 kilo-Hz. The tone penalty also decreased at a mild exponential rate with the absolute level of the broadband noise component. The effect of varying the spectrum of the broadband noise was found to interact with the tone frequency. A general formula relating tone penalty to the variables will be presented in a companion report. Author

N92-22680*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
RESONANT ACOUSTIC DETERMINATION OF COMPLEX ELASTIC MODULI
David A. Brown and Steven L. Garrett *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 32-40 Sponsored in part by Naval Sea Systems Command (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20A

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-22411# Technische Univ., Delft (Netherlands). Interfacultaire Reactor Inst.
MAGNETIC PARTICLES STUDIED WITH NEUTRON DEPOLARIZATION AND SMALL-ANGLE NEUTRON SCATTERING Ph.D. Thesis
Remko Rosman 1991 217 p
(ISBN-90-73861-02-0; ETN-92-91139) Avail: NTIS HC/MF A10

Neutron Depolarization (ND) theory and its application to particulate media are addressed. Additionally, ND and Small Angle Neutron Scattering (SANS) experiments are discussed in the context of a variety of particulate media. An extension of ND theory in the Larmor approach is proposed with the result that the Larmor and scattering approaches become fully equivalent, provided that all scattered neutrons enter the analyzer. The concept of intrinsic anisotropy is explained. Progress in the study of particulate media is reported. It is shown theoretically and experimentally that antiferromagnetism can give rise to ND. Solid Ni containing Kr precipitates were investigated with both ND and SANS. In addition to the presence of Kr bubbles with a diameter of about 3 nm, the presence of much larger nuclear inhomogeneities was deduced. The latter, which may be large Kr bubbles, affect the local magnetization. SANS measurements on Fe3O4 ferrofluids revealed that even in the most dilute fluids subjected to a magnetic field, most of the particles are present as dimers. Larger, three dimensional, aggregates arise at high volume fractions, in particular in an applied magnetic field. ESA

N92-22650# International Centre for Theoretical Physics, Trieste (Italy).
ON THE Q-Q CHANNEL INTERACTION OF THE EFFECTIVE NJL-HAMILTONIAN
A. Ansari Sep. 1991 11 p
(DE92-614198; IC-91/290) Avail: NTIS HC/MF A03

We take the usual simple form of the Nambu-Jona-Lasinio (NJL) Hamiltonian containing only the scalar and pseudoscalar terms with two flavors of massless quarks (u and d). Then making the interaction strength position dependent, as done by Bernard et al., to bringing confinement, we calculate the nucleon (N) and delta (Delta) masses. In this simple form the interaction seems not to contain enough spin-isospin dependence to yield a reasonable value of N - Delta mass difference. Doubts are raised if the NJL interaction, in its simple form, can be employed to study the spectroscopic properties of hadrons. DOE

N92-22651# International Centre for Theoretical Physics, Trieste (Italy).
NUCLEAR INELASTIC SCATTERING CROSS-SECTION FOR TRANSITIONS L=2 AND 3 IN THE STRONG ABSORPTION MODEL
M. A. Rahman and H. M. SenGupta (Dacca Univ., Bangladesh) Jul. 1991 7 p
(DE92-614308; IC-91/167) Avail: NTIS HC/MF A02

Austern and Blair have established the connection between inelastic and elastic nuclear scattering of strongly absorbed particles in the adiabatic approximation. Simple closed expressions again in the adiabatic approximation, under strong absorption condition, for the inelastic scattering cross-section are obtained and made explicit by Potgieter and Frahn; which are analogous to the strong absorption model formulae for elastic scattering. We derive the inelastic scattering cross-section for transitions L = 2 and 3 using their general formulations and test the derived formulae with experiments. DOE

N92-22652# International Centre for Theoretical Physics, Trieste (Italy).
STRONG ABSORPTION MODEL ANALYSIS OF ALPHA SCATTERING
M. A. Rahman, S. ChandraPaul, H. M. SenGupta (Dacca Univ., Bangladesh), and M. Rahman Jul. 1991 16 p
(DE92-614345; IC-91/166) Avail: NTIS HC/MF A03

Angular distribution of alpha particles at several energies, E(sub alpha) = 21 approx. 85.6 MeV from a number of nuclei between Ni-20 and Sn-119, extending to wide angular range up to approx. 160 C in some cases, have been analyzed in terms of three-parameter strong absorption model of Frahn and Venter. Interaction radius and surface diffuseness are obtained from the parameter values rendering the best fit to the elastic scattering data. The inelastic scattering of alpha particles from a number of nuclei, leading to quadrupole and octupole excitations has also been studied giving the deformation parameters (beta sub L). DOE

N92-22732*# Strategic Defense Initiative Organization, Washington, DC. Office of Technology Applications.
APPLICATIONS OF THE STRATEGIC DEFENSE INITIATIVE'S COMPACT ACCELERATORS
Nick Montanarelli and Ted Lynch *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 503-511 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N92-22970# National Lab. for High Energy Physics, Tsukuba (Japan).
EVALUATION OF WAKE FIELDS OF DISK LOADED STRUCTURE FOR JAPAN LINEAR COLLIDER
M. Takao, T. Higo, and K. Takata Jul. 1991 25 p
(DE92-751023; KEK-91-4) Avail: NTIS HC/MF A03

The numerical estimation of the long range wake fields of the accelerating structure for the Japan Linear Collider (JLC) was carried out by using various computer codes; TBCI, KN7C, TRANSVRS, and URMEL. It provides the basis of the argument on the energy distribution or the emittance growth of a multi-bunched beam. A large portion of the transverse wake field was found to be occupied by a dominant mode, lowest in frequency, while the contribution of the other modes were found at most twenty percent. On the wake field of the dominant mode, the estimation of the amount calculated by the above codes agreed within ten percent. The dependence of the wake fields on a geometric variation, i.e., an aperture, was also investigated. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N92-22630# Technische Univ., Delft (Netherlands).
OPTICAL AND MECHANICAL DESIGN FOR 1 nm RESOLUTION AUGER SPECTROSCOPY IN AN ELECTRON MICROSCOPE Ph.D. Thesis

Arno Jan Bleeker 1991 166 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie and Netherlands Technology Foundation
(ETN-92-91144) Avail: NTIS HC/MF A08

The implementation of Auger spectroscopy in a scanning transmission microscope that is used in surface physics and materials is discussed. The design of a dedicated magnetic lens for focusing the primary beam in a 1 nm spot collecting the Auger electrons is discussed. Experiments with a prototype instrument are presented. These experiments show that periodic focusing occurs if the magnetic field in the objective lens is not optimized to extract the Auger and secondary electrons. This means that the transmission of the electrons through the system is not constant and depends on the energy of the electrons. This complicates the interpretation of the spectra. ESA

N92-22449*# Oak Ridge National Lab., TN.
ULTRA-PRECISION PROCESSES FOR OPTICS MANUFACTURING
William R. Martin *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 225-234 Sponsored in part by Strategic Defense Initiative Organization (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

N92-22455*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
FIBER OPTIC TV DIRECT
John E. Kassak *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 271-280 Prepared in cooperation with Boeing Co., Cocoa Beach, FL and Lockheed Missiles and Space Co., Kennedy Space Center, FL (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

N92-22458*# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
FIBER OPTIC-BASED BIOSENSOR
Frances S. Ligler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 300-307 Sponsored in part by Office of Naval Technology and Marine Corps. (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

N92-22722*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
FIBER-OPTIC PUSH-PULL SENSOR SYSTEMS
David L. Gardner, David A. Brown, and Steven L. Garrett *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 415-422 Sponsored in part by NOAA and Naval Sea Systems Command (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20F

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N92-22139 Texas Univ., Arlington.
A NEW INTEGRAL METHOD FOR MAGNETOHYDRODYNAMIC (MHD) FLOW ANALYSIS Ph.D. Thesis
Ying-Ming Lee 1991 142 p
Avail: Univ. Microfilms Order No. DA9131751

A new magnetohydrodynamic (MHD) analysis and simulation model is developed to provide analysis of current MHD test data and simulation of higher interaction prototypical hardware. An analytic approximation of the turbulent boundary layer velocity profile has been used to describe attached and near separated MHD flow over the entire computational domain. The velocity profile model has been validated with available incompressible and compressible non-MHD turbulent boundary layer flow experimental data. A lag equation is introduced into the turbulent boundary layer calculations and shows good agreement with experiments. A analytic description of the temperature as a function of velocity, through a MHD turbulent boundary layer for constant but non-unity Prandtl number, has been derived in this study to provide a better representation of the MHD enthalpy layer profiles. The model has been tested against non-MHD cases and shows good agreement. An improved electrical model has been coupled with the code to prove the electrical distribution throughout the flow field. The combined code is able to solve the MHD flow equations in a marching fashion for fast calculations and simulate Faraday and link resistor supported diagonal generator loadings. Results of the computer model are compared with experimental data.
Dissert. Abstr.

N92-22220# Lawrence Livermore National Lab., CA.
HIGH-CONTRAST RATIO POWER MEASUREMENTS WITH A STREAK CAMERA
R. A. Lerche, D. S. Montgomery, and J. D. Wiedwald 10 Sep. 1991 8 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE92-006904; UCRL-106484; CONF-9107115-66) Avail: NTIS HC/MF A02

Future multibeam laser-fusion experiments will require that beam powers be determined with better than 5 percent precision over a range approaching 40 to 1. In this paper, statistical, dispersive, and nonlinear factors which greatly influence such measurements are discussed. We conclude such that such measurements can be made with 30-ps temporal resolution using an optical streak cameras. DOE

N92-22918# Ecole Polytechnique, Palaiseau (France).
THE LABORATORY FOR THE USE OF HIGH-ENERGY LASERS Scientific Report, 1990 [LABORATOIRE POUR L'UTILISATION DES LASERS INTENSES: RAPPORT SCIENTIFIQUE 1990]
Michel Koenig, ed. and Danielle Smadja, ed. May 1991 272 p In FRENCH
(ETN-92-91030) Avail: NTIS HC/MF A12

Experiments carried out on laser matter interactions from 1990 are described. Brillouin retrodiffusion in laser matter interactions, resonant absorption, target compression, and radiative energy transfer are studied. Plasma density homogeneity and filamentation are discussed. Random phase plate effects on Brillouin and Raman diffusion are studied. Implosion reactions are considered. Spectroscopic methods of plasma temperature determination are studied. Use of lasers in compacting porous compressed powder materials is studied. Other laser applications are considered. For individual titles, see N92-22919 through N92-22960.

N92-22919# Ecole Polytechnique, Palaiseau (France). Centre de Physique Theorique.
EVOLUTION OVER TIME OF DAUGHTER WAVELENGTH ENERGIES IN A BRILLOUIN RETRODIFFUSION INSTABILITY. APPLICATIONS IN PARTICLE ACCELERATION EXPERIMENTS USING WAVELENGTH BEATING [EVOLUTION AU COURS DU TEMPS DES ENERGIES DES ONDES FILLES DANS L'INSTABILITE DE RETRODIFFUSION BRILLOUIN. APPLICATION AUX EXPERIENCES D'ACCELERATION DE PARTICULES PAR BATTEMENT D'ONDES]
Philippe Mounaix, Guy Laval, Denis Pesme, and Wojtek Rozmus *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 1-10 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The asymptotic behavior of the Brillouin instability is studied. In regimes where the instability is of a convective nature, the growth of a perturbation is finite in the case of a plasma of finite

length. The reflectivity depends on the level of thermal fluctuations. Two goals are sought in carrying out the calculations: to calculate the Brillouin reflection over time in the event of interactions and to study the level of sonic waves in the areas where the weakening of the pump flux is negligable. ESA

N92-22920# Nice Univ. (France). Lab. de Physique de la Matiere Condensee.
LONGITUDINAL MODES OF THE BRILLOUIN CAVITY RING [MODES LONGITUDINAUX DE LA CAVITE BRILLOUIN EN ANNEAU]
Jean Botineau, Carlos Montes, and Eric Picholle *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 11-14 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The longitudinal modes of the Brillouin cavity ring are studied using silica unimodal optic fibers. Mathematical simulation of the Brillouin model indicates that in a typical evolution scenario towards continuous retrodiffusion, amplitudes stabilize much more quickly than the phases. The persistence and stability of these phase oscillations weighs in favor of the existence of an asympotic regime in which the Stokes frequency is altered compared to the theoretic frequency. Various analytic solutions for optic buffering of this type are presented. ESA

N92-22921# Paris XI Univ., Orsay (France). Lab. de Physique des Gaz et des Plasmas.
RESONANT ABSORPTION IN A PARABOLIC DENSITY PROFILE [ABSORPTION RESONANTE DANS UN PROFIL DE DENSITE PARABOLIQUE]
Arnaud Chiron, Brigitte Cros, Jacques Godiot, and Gilles Matthieussent *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 15-20 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Resonant absorption of an electromagnetic wave in an inhomogeneous plasma is studied in terms of it's application to the physics of laser-matter interactions, ionospheric heating experiments, and microwave experiments in the laboratory. Electronic plasma waves are excited to a ,resonant position at which the frequency of the local plasma is equal to the incident wave frequency. When the amplitude of the plasma waves is increased, nonlinear effects appear. These mechanics are studied within a parabolic profile density. Zakharov equations are used to model the plasma wave propagation coupled to the acoustic ionic waves. ESA

N92-22922# Ecole Polytechnique, Palaiseau (France). Lab. de Physique des Milieux Ionises.
THE 1D1/2 SIMULATION: APPLICATION TO THE PLASMAS OF LASERS X RAY RECOMBINATION [SIMULATIONS 1D1/2: APPLICATION AUX PLASMAS DE LASER X PAR RECOMBINATION]
Jean Virmont, Nicolas Grandjouan, and Annie Klisnick (Paris-Sud Univ., Orsay, France) *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 21-26 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Two dimensional effects in the simulation of x-ray recombination are studied. A model of 1D1/2 (one dimensional 1/2) is developed. The model is one dimensional in terms of the normal direction of the target. It, however, takes the hydrodynamic expansion parallel to the direction of the target into account by using an OD description. Simulations carried out using the 1D1/2 simulations with fixed Z values lead to thermal and density evolutions close to those found in atomic physics. The 2D code is adapted for carrying out simulation of plasma recombination using a nonuniform grid. ESA

N92-22923# Ecole Polytechnique, Palaiseau (France). Lab. de Physique des Milieux Ionises.
TWO DIMENSIONAL SIMULATIONS FOR A LASER X RAY RECOMBINATION [SIMULATIONS BIDIMENSIONNELLES POUR LE LASER X PAR RECOMBINAISON]
Nicolas Grandjouan and Jean Virmont *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 27-30 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The need to develop a new Lagrangian grid to take the mechanical and thermal exchanges between the hot plasma and the cold target into account is stressed. A simplified version of the Eulerian code MAG2D is used to simulate the corona during rapid cooling. In this MAG2D code, the grid is fixed. Convective processes are addressed using an explicit algorithm with corrected flux, while the diffusive aspects of the problem are described using an iterative method. The model operates within a two dimensional cartersian geometry. The problem being considered is stretched to infinity in the third Z dimension. ESA

N92-22924# Toulouse Univ. (France).
INFLUENCE OF CERTAIN ATOMIC PROCESSES ON THE COMPRESSION OF TARGETS FILLED WITH D-T [INFLUENCE DE CERTAINS PROCESSUS ATOMIQUES SUR LA COMPRESSION DE CIBLES REMPLIES DE D-T]
Dominaccio Mostacci, Jean-Pierre Dinguirard, L. Montierth, and Pascal Marcerou *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 31-35 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Radiative energy transfer from the target zone to the filling gas is studied. A drop on energy is associated with each photoionization reaction. The electron released in this reaction has a kinetic energy which may be higher or lower than the average thermal energy of the plasma electrons. The overall effect of photionization is to heat or cool down the plasma. The ionization state is calculated according to the tables established by the Summers method, modified to take photoionization into account. ESA

N92-22925# Toulouse Univ. (France).
A CODE FOR THE STUDY OF RADIATIVE TRANSFER USING RESULTS OF A HYDRODYNAMIC CODE: BETTY [UN CODE POUR L'ETUDE DU TRANSFERT RADIATIF A PARTIR DES RESULTATS D'UN CODE HYDRODYNAMIQUE: BETTY]
Pascal Marcerou, Jean-Pierre Dinguirard, and Dominaccio Mostacci *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 36-39 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Subsequent to the development of a Lagrangian two dimensional hydrodynamic code, a code is developed for the study of radiative transfer. The code works in a post-processor mode using randomly sampled results from the hydrocode. The goal of the code is to calculate x-ray emission at a given point and direction. The x-ray radiation is defined based on transitions for one or from several two level systems. Two stages are, therefore, involved in the course of a simulation: calculation of the populations of different levels considered, followed by resolution of the radiative transfer equation to calculate the corresponding X-ray radiation. ESA

N92-22926# Toulouse Univ. (France).
X PULSE RADIATION THROUGH THE CRITICAL SURFACE [RAYONNEMENT X PULSE PAR LA SURFACE CRITIQUE]
Cecile Arnas, Jacques Briand, Jean-Francois Moor, Alain Gomes, and Michel Armengaud *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 40-43 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Pulsed x-ray emission by a plasma interacting with a high flux laser is studied. Apparition levels are determined and experimental evolution laws are established. A streak x-ray camera with a vertical

slot 100 micrometers in width and a hole 210 micrometers in diameter is used in imaging the plasma. The camera allows lateral emission of the interaction zone to be registered. An angle of seven degrees to the plane of the target is chosen in order to avoid direct nonconverted x-rays produced by the cesium iodide photocathode. ESA

N92-22927# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

STUDY OF HOMOGENEITY IN THE DENSITY OF LONG PLASMAS FOR WAVELENGTH PULSING EXPERIMENTS [ETUDE DE L'HOMOGENEITE DE LA DENSITE DES PLASMAS LONGS POUR LES EXPERIENCES DE BATTEMENT D'ONDES]

Francois Amiranoff, Anthony Dyson, Jean-Raphael Marques, Christian Stenz, P. Benkheiry, C. Gregory, F. Jacquet, P. Mine, B. Montes (Laboratoire de Physique Nucleaire des Hautes Energies, Palaiseau, France), and P. Poilleux et al *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 44-49 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Two lasers with wavelengths of 1.053 and 1.064 micrometers, respectively, are used to generate intense electric fields in a plasma in order to accelerate charged particles. A long homogeneous plasma at least 5 mm in length is needed in order to diagnose the plasma. The plasma is obtained by multiphotoionization of deuterium or hydrogen at a pressure of 23 millibars. If the ionization is total, the density of the plasma obtained near the focusing tens of the laser is equal to the initial density of the atoms in the test chamber. Study of the plasma by Thomson diffusion allows analysis of evolution in density and temperature. ESA

N92-22928# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

EXPERIMENTAL STUDY OF FILAMENTATION IN LOW DENSITY PLASMAS [ETUDE EXPERIMENTALE DE LA FILAMENTATION EN PLASMA SOUS-DENSE]

Sophie D. Baton, Thierry Jalinaud, Christine Labaune, and H. A. Baldis (National Research Council of Canada, Ottawa, Ontario) *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 50-55 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Filamentation is a parametric instability, the main consequence of which is to divide the laser beam into smaller beams of low density which funnel light and, therefore, augment the local intensity. Filamentation can be very dangerous as it acts directly on the uniformity of an implosion and can facilitate the triggering of other instabilities. Experimental identification of filamentation of the laser beam in a preformed plasma, and correlation of the presence of filamentation with the development of Raman and Brillouin instabilities are performed. ESA

N92-22929# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

EFFECT OF A RANDOM PHASE PLATE ON BRILLOUIN AND RAMAN DIFFUSION STIMULATED IN PREFORMED PLASMAS [EFFET DES LAMES DE PHASE ALEATOIRE SUR LES DIFFUSIONS BRILLOUIN ET RAMAN STIMULEES EN PLASMA PREFORME]

Thierry Jalinaud, Sophie D. Baton, Christine Labaune, and H. A. Baldis (National Research Council of Canada, Ottawa, Ontario) *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 56-61 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Reverse diffusion levels of Brillouin and Raman instabilities are compared in preformed plasmas with and without phase layering. Severe reduction in Brillouin and Raman levels is found when short term layers are placed on the interacting laser beam. This reduction is due either to incoherence in the laser or to a reduction in filamentation and interaction length. These initial results in the area of laser activated fusion help in pointing out areas where further reasearch is needed. ESA

N92-22930# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

OBSERVATION OF COUPLING BETWEEN STIMULATED RAMAN AND BRILLOUIN DIFFUSION [OBSERVATION DU COUPLAGE ENTRE LES DIFFUSIONS RAMAN ET BRILLOUIN STIMULEES]

Christine Labaune, H. A. Baldis (National Research Council of Canada, Ottawa, Ontario), Sophie D. Baton, Thierry Jalinaud, and Denis Pesme *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 62-67 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

The Stokes and anti-Stokes components of stimulated Raman diffusion are investigated. The frequencies of these components are symmetric to the fundamental frequency of the laser, and their frequency fluctuations are a function of the density and electronic temperature of the plasma. The anti-Stokes component results from the diffusion of an incident photon in the plasma wave excited by the Raman instability. It is seen that, no matter the geometry of the Raman decomposition, the anti-Stokes component is always emitted forward. ESA

N92-22931# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

GOLD SPECTRUM TRANSPORT THROUGH A PLASTIC SHEET [TRANSPORT D'UN SPECTRE D'OR A TRAVERS UNE FEUILLE DE PLASTIQUE]

Rene Benattar and Aybars Sezen *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 68-71 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

The transport zones of laser produced plasmas are studied. Temporal resolution of spectroscopic absorption in the x-ultraviolet region is used on plastic targets covered with a thin gold film. The gold layer is thin enough such that the radiation emitted by the gold does not significantly alter the temperatures of the plastic target. Mylar targets of 6 and 1.5 micrometers are covered with 50, 100, and 150 angstrom layers of gold. The experiments carried out are shown in diagrammatic form. ESA

N92-22932# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

USE OF AN ATOMIC CLOCK IN IMPLOSION TIMING EXPERIMENTS [CHRONOMETRIE NEUTRONIQUE SUR LES EXPERIENCES D'IMPLOSION]

Victor Malka, Michel Koenig, Edouard Fabre, Peter Hammerling, Dimitri Batani, Alain Michard, Jean-Michel Boudenne, J. P. Garconnet, and P. Fews (Bristol Univ., England) *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 72-76 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

An atomic clock is used to determine at which phase of implosion fusion reactions occur. A fast scintillation detector is used for this purpose. The detector is an Ne 111 scintillator doped with benzophenon coupled to a high speed oscilloscope. The mounting time for the detector is 0.3 nanoseconds for laser light and 0.6 nanoseconds for neutrons. The technique gives the number of neutrons and the delay between maximum neutron emission and maximum laser impulse. ESA

N92-22933# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

HEART OF IMPLOSION IMAGERY EXPERIMENTS [IMAGERIE DU COEUR DANS LES EXPERIENCES D'IMPLOSION]

Michel Koenig, Victor Malka, Edouard Fabre, Peter Hammerling, Dimitri Batani, Alain Michard, Jean-Michel Boudenne, and P. Fews (Bristol Univ., England) *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 77-80 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

The use of heart of explosion imagery in measuring hydrodynamic production is studied. Experimental results indicate

that only a small volume of combustible material is raised to a high enough temperature for fusion reactions to occur. Lack of uniformity in fuel heating is suspected to be responsible for disparities observed between calculated and experimental neutron counts. A shadow image deconvolution technique gives good spatial resolution of neutron emission. Results of applications of this technique to implosion imagery experiments are described. ESA

N92-22934# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

LASER-MATTER INTERACTIONS WITHIN A CONFINED GEOMETRY [ETUDE DE L'INTERACTION LASER-MATIERE EN GEOMETRIE CONFINEE]

David Devaux, Remy Fabbro, and Jean Virmont *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 81-84 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Plasma pressure under various conditions is studied for applications in metallurgy. Spectroscopic methods of plasma temperature determination are described. Various surface coverings are tested to determine their laser energy absorption, their shock wave attenuation, and their ability to protect the metallic surface from thermal effects. The pressure induced in a glass container and the plasma deterioration induced by the containment are measured using a quartz sensor. ESA

N92-22935# Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers (France). Lab. d'Energetique et de Detonique.

MODELING POROUS MATERIALS UNDER SHOCK [MODELISATION DES MATERIAUX POREUX SOUS CHOC]

Jean-Pierre Romain, Didier Zagouri, M. Jeandin, and B. Dubrujeaud (Ecole des Mines, Paris, France) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 85-91 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Shock waves as a means of compacting porous, compressed powder materials are studied. The use of lasers as a means of compacting such materials is discussed. Using a laser, the pressure can be maintained for several nanoseconds compared to the microseconds of more traditional pressure producing solutions. The compacting effects of laser shock is shown to occur only in the superficial layers of the material. Shock propagation on porous materials is studied in view of developing an analysis method applicable to the results of laser shock induced densification experiments. ESA

N92-22936# Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers (France). Lab. d'Energetique et de Detonique.

DYNAMIC DAMAGE OF ALUMINUM, COPPER, AND IRON TARGETS BY LASER SHOCK: NUMERICAL STUDY OF STEPPED TARGET SPALLATION [ENDOMMAGEMENT DYNAMIQUE PAR CHOC LASER DE CIBLES D'ALUMINIUM, DE CUIVRE ET DE FER: ETUDE NUMERIQUE DE L'ECAILLAGE DE CIBLES A MARCHE] **c26**

Francis Cottet, Michel Boustie, and Thibaut deResseguier *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 92-98 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Fracturing of targets submitted to laser shocks is studied. Ways of avoiding or alternatively making use of such fracturing phenomena are described. Ways in which the target material influences fracturing effects are studied. The use of targets with stepped backs is analyzed by means of a two dimensional code. Cumulative damage codes are used to determine the influence of the target material, aluminum, copper, or iron on cracking size and thickness. ESA

N92-22937# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.

RESIDUAL CONSTRAINTS INDUCED BY LASER SHOCK: APPLICATION TO METALLIC STRUCTURE FATIGUE RESISTANCE IMPROVEMENT [CONTRAINTES RESIDUELLES INDUITES PAR CHOC-LASER. APPLICATION A L'AMELIORATION DE LA TENUE EN FATIGUE DES STRUCTURES METALLIQUES] **c26**

Patrick Ballard *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 99-104 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

The effect of impact on metallic structures is analyzed in order to be able to evaluate the residual constraints induced. Laser-matter interaction is constrained and modeled in order to describe the impact parameters resulting from the radiation. The results of the experiments are compared to theoretical results in order to validate the model. Optimal radiation parameters are determined and fatigue tests are presented to demonstrate the efficiency of laser shock as a means of surface treatment. ESA

N92-22938# Quebec Univ., Varennes.

PLASMA PARAMETERS AND CONVERSION RATES IN LASER-SOLID INTERACTIONS AT 0.26 MICROMETERS: APPLICATION TO THE CALCULATION OF RADIATIVE LOSSES IN HYDRODYNAMIC SIMULATIONS [PARAMETRES DE PLASMA ET RENDEMENT DE CONVERSION DANS L'INTERACTION LASER-SOLIDE A 0.26 MICROMETRES: APPLICATION AU CALCUL DES PERTES RADIATIVES DANS LES SIMULATIONS HYDRODYNAMIQUES] **c36**

S. Boily (Ecole Polytechnique, Palaiseau, France) and Jean-Claude Gauthier *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 105-109 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

Application of x-ray technology to microlithography is studied. Numerical modeling of conversion and flux in x-rays in terms of the material to be etched is carried out. The model is validated by comparing the results of x-spectrum calculations and conversion rates with the corresponding experimental results. A method of temperature and density determination on the sub-keV emission zones 100 to 800 eV and 800 to 2000 eV is developed. The x-SOURCE model allows for simple calculation of the spectral density of the energy emitted in the x-domain by laser produced plasmas. ESA

N92-22939# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.

COHERENCE TRANSITION IN AN X LASER. NUMERIC CODE FOR THE BLOCH-MAXWELL EQUATIONS [TRANSITION VERS LA COHERENCE DANS UN LASER X: CODE NUMERIQUE POUR LES EQUATIONS DE BLOCH-MAXWELL] **c36**

Patrick Lautard, Alain Sureau, and Pierre Jaegle *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 111-118 In FRENCH (For primary document see N92-22918 13-75)

Avail: NTIS HC/MF A12

A Bloch-Maxwell equation resolution code is described. The influence of polarization on propagation is studied. Coherence and possibilities of radiation amplification are considered. The model is based on the hypothesis that the plasma is homogeneous. The choice of initial conditions is determined to be fundamental. The cylindrical geometry of the plasma is taken into account. The column of plasma of interest is considered to be off-axis. ESA

N92-22940# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.

OPTIMIZATION OF PLASMA CONFINEMENT GAIN [OPTIMISATION DU GAIN PAR CONFINEMENT DU PLASMA]

Jean-Pierre Raucourt, Annie Klisnick, Antoine Carillon, P. Dhez, Bernard Gauthe, Gerard Jamelot, P. Goedtkindt, and Pierre Jaegle *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 119-122 In FRENCH (For

primary document see N92-22918 13-75)
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Confining a plasma between walls is shown to significantly add to its gain coefficient as long as the shape of the target allows the beam to be tightly enough confined. Techniques of accelerating the cooling by means of doping with heavy elements do not produce any increase in gain. It is concluded that research into better means of confining plasmas and ways of adapting such methods to multibeam experiments are required. ESA

N92-22941# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
X-ULTRAVIOLET GAIN MODELING IN A PLASMA OF ALUMINUM CREATED FROM A MASSIVE TARGET: 1D1/2 FILM CODE [MODELISATION DU GAIN X-UV DANS UN PLASMA D'ALUMINIUM CREE A PARTIR D'UNE CIBLE MASSIVE: CODE FILM 1D1/2]
Annie Klisnick, Alain Sureau, Helene Guennou, Claire Moeller, Jean Virmont, and Nicolas Grandjouan (Ecole Polytechnique, Palaiseau, France) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 123-128 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The effect of x-ultraviolet gain on two factors which can influence cooling are studied. The transverse dimensions of the plasma and thermal conductivity towards the cold target are the two factors studied. The gain coefficient produced by recombination of helium and lithium ions is strongly affected by the cooling rates of the plasma after the laser impulse. FILM 1D1/2 simulations are used to examine the effects on the X-UV gain of the two factors able to influence the cooling of the plasma. ESA

N92-22942# Quebec Univ., Varennes.
QUANTITATIVE STUDY OF INHOMOGENEITIES IN AN ALUMINUM PLASMA USING MONOCHROMATIC IMAGERY [ETUDE QUANTITATIVE DES INHOMOGENEITES D'UN PLASMA LIGNE D'ALUMINIUM PAR IMAGERIE MONOCHROMATIQUE]
J. C. Kieffer, Antoine Carillon, P. Dhez, Bernard Gauthe, Pierre Jaegle, Gerard Jamelot, Annie Klisnick, Jean-Pierre Raucourt, and Alain Sureau (Ecole Polytechnique, Palaiseau, France) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 129-133 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Inhomogeneities in plasma parameters and their effect in gain for different amplifitation schemes are studied. Monochromatic image diagnosis is used to quantify a 300 mm long aluminum plasma. The quantitative diagnosis method is shown to work well for large scale plasmas. Large inhomogeneity is found in the plasma parameters due to radiation quality. Large scale inhomogeneities directly related to variations in illumination are studied. Combining the diagnostic method with spatial resolution allows high frequency fluctuation effects to be studied quantitatively. ESA

N92-22943# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
ATOMIC DATA FOR A RECOMBINATION X LASER SCHEME [DONNEES ATOMIQUES POUR UN SCHEMA DE LASER X PAR RECOMBINAISON] **c36**
Helene Guennou, Annie Klisnick, Claire Moeller, and Alain Sureau *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 134-139 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Ionic energy levels, transition wavelengths, ionization values, recombination, oscillatory forces, and transition probabilities are some of the parameters taken into account in developing a model of an x laser scheme. Detailed calculation of these parameters is carried out for a helium to lithium ion recombination system. Lithium type ions of aluminum, sulfur, chlorine, potassium, calcium, and titanium are studied. The excitation levels of the various types of ions produced in these reactions are calculated. ESA

N92-22944# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
AMPLIFICATION AT 65 A OF LITHIUM-LIKE SULFUR [AMPLIFICATION A 65 A DANS LE SOUFRE LITHUMOIDE] **c36**
Jean-Pierre Raucourt, Antoine Carillon, Bernard Gauthe, Pierre Jaegle, Gerard Jamelot, and Annie Klisnick *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 140-143 In FRENCH (For primary document see N92-22918 13-75)
(Contract DRET-88-236)
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Lithium like sulfur ions are investigated as a means of developing a low priced x-laser source. Such a laser within the window of water at about 40 angstroms, would lead to diverse biological applications of laser technology. These two goals are worked towards in studying pumping by recombination of lithium like aluminum. Other elements in the same periodic table column are tested using increasingly greater laser fluxes. ESA

N92-22945# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
AMPLIFICATION OF NONCHROMATIC RADIATION POLARIZED IN A LINEAR FASHION BY AN ATOMIC SYSTEM WITH TWO DEGENERATED LEVELS [AMPLIFICATION D'UN RAYONNEMENT MONOCHROMATIQUE, POLARISE LINEAIREMENT, PAR UN SYSTEME ATOMIQUE A DEUX NIVEAUX DEGENERES]
Alain Sureau *In* Ecole Polytechnique, The Laboratoey for the Use of High-Energy Lasers May 1991 p 144-149 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Level degeneration is taken into account within the framework of the Bloch-Maxwell equations. The state of an ion with two degenerated levels in which the polarization vector is aligned with the macroscopic electric field vector is elucidated. The ion can be amplified without modifying its direction. Reasons for the disadvantage of J equal to O leading to J prime equal to 1 transitions as compared to J equal to 2 leading to J prime equal to 1 transitions, are derived. ESA

N92-22946# Ecole Polytechnique, Palaiseau (France). Lab. de Physique de Milieux Ionises.
ABSORPTION TRANSITION BEAMS: THEORY AND EXPERIMENTS [FAISCEAUX DE TRANSITIONS EN ABSORPTION: THEORIE ET EXPERIENCE]
Jean-Claude Gauthier, Jean-Paul Geindre, Claude Chenais-Popovics, M. Louis-Jacquet, J. Bruneau, D. Desenne, D. Naccache, C. Bauche-Arnoult, and J. Bauche (Centre National de la Recherche Scientifique, Orsay, France) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 150-155 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The statistical parameters of the theory are shown to be useful in simulating complex spectra when the transition beams of each configuration of each ion are resolved or partially resolved. The statistical method used involves approximately 100 entry parameters to simulate the overlapping of 520,000 rays. Comparison of absorption spectra over time with the results of hydrodynamic and statistical simulation, shows close agreement. ESA

N92-22947# Ecole Polytechnique, Palaiseau (France). Lab. de Physique des Milieux Ionises.
SPATIAL-TEMPORAL MEASUREMENT OF THE IONIZATION STATE OF A PLASMA BY SPECTROSCOPIC ABSORPTION [MESURE SPATIO-TEMPORELLE DE L'ETAT D'IONISATION D'UN PLASMA PAR SPECTROSCOPIE D'ABSORPTION]
Christina A. Back, Claude Chenais-Popovics, Patrick Renaudin,

Patrick Audebert, Jean-Paul Geindre, and Jean-Claude Gauthier *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 156-161 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Absorption spectography for K alpha and L alpha, beta rays is shown to be a powerful diagnostic tool for hot plasmas with Z values between 10 and 40. The technique is used to measure the ionization state, the electronic temperature, and the density integrated along the observation axis for relatively dense plasma at temperatures between 30 and 150 eV. Radiative heating of a plasma, and the plasma temperature reached are studied by means of this technique. ESA

N92-22948# Ecole Polytechnique, Palaiseau (France). Lab. de Physique des Milieux Ionises.
PHOTOIONIZATION OF AN ALUMINUM PLASMA BY A TANTALUM X SOURCE [PHOTOIONISATION D'UN PLASMA D'ALUMINIUM PAR UNE SOURCE X DE TANTALE]
Patrick Renaudin, Christina A. Back, Claude Chenais-Popovics, Patrick Audebert, Jean-Paul Geindre, and Jean-Claude Gauthier *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 162-167 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Photoionization of a helium like aliminum plasma is carried out by an external x-source. The laser beam used corresponds to the 3d to 4F transition level of tantalum. The experimental spectrum of tantalum is shown superimposed over the emission spectrum of aluminum on diagrammatic form. Good correspondence is seen between the 3d to 4F emissions of tantalum and helium like aluminum. Plasma pumping is obtained by exposure of a tantalum target to laser rays. ESA

N92-22949# Paris VI Univ. (France). Lab. de Spectroscopie Atomique des Plasmas.
ATOMIC STRUCTURE AND SPECTRAL PERTURBATIONS IN HOT DENSE PLASMAS [STRUCTURE ATOMIQUE ET PERTURBATIONS SPECTRALES DANS LES PLASMAS DENSES ET CHAUDS]
Hoe Nguyen, Jeanne Grumberg, Elisabeth Leboucher-Dalimier, Philippe Malnoult, Jean-Pierre Arranz, Monique Brisard, Abdelkader Reggadi, and Alain Poquerusse (Ecole Polytechnique, Palaiseau, France) *In* Ecole Polytechnique, The Laboratoey for the Use of High-Energy Lasers May 1991 p 168-176 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Interaction mechanisms between the quantic structures of multicharged ions and dense plasmas are studied. The theoretical research aims at better understanding the microscopic aspects of equilibrium equations in ultradense plasmas and at developing optical diagnostic methods for such plasmas. It is concluded that the facilities allow such research to be performed. ESA

N92-22950# Paris VI Univ. (France). Lab. de Spectroscopie Atomique des Plasmas.
EXPERIMENTAL STUDY OF X RAYS EMITTED BY DENSE AND ULTRADENSE ZONES OF A LASER PLASMA FROM A PLANAR TARGET [ETUDE EXPERIMENTALE DES RAIES X EMISES PAR LES ZONES DENSE ET ULTRADENSE D'UN PLASMA DE LASER ISSU D'UNE CIBLE PLANE]
Elisabeth Leboucher-Dalimier, Alain Poquerusse (Ecole Polytechnique, Palaiseau, France), Jeanne Grumberg, Monique Brisard, and Hoe Nguyen *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 177-185 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Transverse inhomogeneity in a plasma is studied by means of spectral form analysis and the intensity of the rays emitted by an aluminum plasma. Radiative transfer effects are shown to be useful in the diagnosis of the inhomogeneity. In zone 1, strong asymmetry is seen in the red wavelengths of AlH(sub beta) leading to an apparent blue shift of AlHe(sub epsilon). In zone 2, the theoretic position of AlHe(sub epsilon) is returned. Comparison of profiles from very high density and from lower densities shows a red shift from AlH(sub beta) of 0.004 angstrom. ESA

N92-22951# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
STUDY OF HOMOGENEITY IN PLASMA COLUMNS FOR X-LASERS: X IMAGERY DIAGNOSTICS AND TESTING OF A RANDOM PHASE PLATE [ETUDE DE L'HOMOGENEITE DES COLONNES DE PLASMA POUR LE LASER X: DIAGNOSTIC PAR IMAGERIE X ET ESSAI D'UNE LAME DE PHASE ALEATOIRE]
Pierre Jaegle, P. Dhez, Annie Klisnick, Antoine Carillon, Bernard Gauthe, Gerard Jamelot, Jean-Pierre Raucourt, and P. Goedtkindt (European Atomic Energy Community, Geel, Belgium) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 187-192 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

A Random Phase Plate (RPP) is used to reduce the characteristic size of the inhomogeneities in order to facilitate their smoothing by hydromechanic means. An RPP, specifically designed for linear Z focalization is tested. The homogeneity of the plasma along its axis is checked by means of x imagery using a multistenopic system in combination with a charge coupled device camera. The obtained results are compared with calculated predictions of the intensity distribution within the focal plane of the system. ESA

N92-22952# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
LASER DIAGNOSTICS IN IMPLOSION EXPERIMENTS [DIAGNOSTICS LASER DANS LES EXPERIENCES D'IMPLOSION] **c36**
Michel Koenig, Victor Malka, Edouard Fabre, Dimitri Batani, Anne-Marie Tournade, Alain Michard, and Jean-Michel Boudenne *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 193-198 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

To better understand phenomena such as premature stopping of fusion reactions, diagnostic techniques related to the quality of the laser beam when it reacts with the target are required. Two diagnostic techniques are developed. One technique measures the focal point, the other measures impulse duration at 0.26 micrometers. The experimental results are combined with calculations which help analyze the causes of existing faults and help in coming up with ways of resolving these faults. ESA

N92-22953# Ecole Polytechnique, Palaiseau (France). Lab. de Physiques des Milieux Ionises.
STUDY OF FOCAL PATCHES AND ABLATION OF TIN AND SAMARIUM LAYERS WITH A RANDOM PHASE PLATE AT WAVELENGTHS OF 0.53 MICROMETERS [ETUDE DES TACHES FOCALES ET DE L'ABLATION DE COUCHES D'ETAIN ET SAMARIUM AVEC UNE LAME DE PHASE ALEATOIRE A LA LONGUEUR D'ONDE 0.53 MICROMETRES] **c36**
Claude Chenais-Popovics, Patrick Renaudin, Christina A. Back, Patrick Audebert, Jean-Paul Geindre, and Jean-Claude Gauthier *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 199-204 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Focusing tests are carried out at wavelengths of 0.53 micrometers. The focal patches and x-ray images obtained with and without a random phase plate are compared in different focusing positions. The random phase plate consists of a glass side divided into squares of 2.5 cm a side, covered or uncovered by a plastic layer which changes the phase of pi rays passing through the slide. The random phase plate is used in conjunction with a focal lens with an aperture of 250 mm. ESA

N92-22954# Paris-Sud Univ., Orsay (France).
MULTISLOT CCD CAMERA FOR THREE DIMENSIONAL X IMAGING OF LASER PLASMAS: INSERTION IN A 6 BEAM CHAMBER AND RESULTS [CAMERA MULTIFENTES A CCD POUR L'IMAGERIE X TRI-DIMENSIONNELLE DE PLASMAS LASER: IMPLANTATION DANS L'ENCEINTE 6 FAISCEAUX ET RESULTATS] **c35**
N. deBeaucoudrey, A. Bellemain, D. Phalippou, Jean-Michel Boudenne, Michel Koenig, and Alain Michard (Ecole Polytechnique, Palaiseau, France) *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 205-210 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

A three dimensional microimaging system using x-ray emission of laser induced plasmas is described. The basis of multislot coding and development of a direct electronic detection code by a CCD (Charge Coupled Device) is discussed. A six beam test chamber designed for tomographic image reconstruction is described. The viewing angle is determined to be too reduced for good tomographic resolution. The possibility of using two identical cameras in two different directions to permit three dimensional reconstruction is investigated. ESA

N92-22955# Ecole Polytechnique, Palaiseau (France). Lab. de Physique des Milieux Ionises.
SPATIAL AND TEMPORAL RESOLUTION SPECTROSCOPY [SPECTROGRAPHIE A RESOLUTION SPATIALE ET TEMPORELLE] **c35**
Christina A. Back, Claude Chenais-Popovics, and Jean-Claude Gauthier *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 213-217 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

A spectrograph consisting of two Bragg crystals combined with a StripLine Imager for X-rays (SLIX) integral image camera is described. The spectrograph is designed to use TIAP crystals. The wavelengths covered are between 3 and 11 angstrom. The SLIX camera allows for registration of x-rays after a short exposure of 150 ps at 1 ns over 1. The advantage of such a spectrograph is that two dimensional image can be obtained for an exposure of less than the x-ray emission. Various research applications of the spectrograph are summarized. ESA

N92-22956# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
ADAPTING A NEW SCANNING SLOT CAMERA FOR OPTICAL X ULTRAVIOLET GLANCING INCIDENCE [ADAPTATION D'UNE NOUVELLE CAMERA A BALAYAGE DE FENTE POUR L'OPTIQUE X-UV SOUS INCIDENCE RASANTE] **c35**
Antoine Carillon, Gerard Jamelot, and Pierre Jaegle *In* Ecole Polytechnique, The Laboratory for the Use of High-Energy Lasers May 1991 p 218-222 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Work involved in transforming a scanning slot camera for use in glancing angle spectroscopy is described. Diagrams of the original Kentech camera are presented. Preliminary tests of the camera carried out to determine possible solutions are described. The solution chosen for modification of the camera is discussed. Diagrams of the modifications are presented. Several examples of temporal results using the modified camera are shown. ESA

N92-22957# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
EXPERIMENTAL TECHNICAL GROUP [GROUPE TECHNIQUE EXPERIMENTAL] **c35**
Jean-Michel Boudenne, Pascal Godeau, Raymond Konig, Patrick Legriel, Alain Michard, and Henri Timsit *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 223-225 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Interfacing of a frame camera is described. The upper part of the camera must be in a state of differential vacuum. Diagrams of the camera are presented. Photographs of the entire experimental apparatus are shown. Ways in which the camera can be used for imaging the heart of an explosion are shown. The technical solutions used in making the camera and test chamber are described. Experimental settings and techniques for optimizing the quality of results are described. ESA

N92-22958# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
ACTIVITIES OF THE ELECTRONICS GROUP [ACTIVITE DU GROUPE ELECTRONIQUE] **c33**
Jean Maignan, Jean-Luc Paillard, and Daniel Chisin *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 226-227 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The activities of the electronics group over the course of 1990 are summarized. Electrical maintenance of the laser and development of apparatus needed to carry out scientific experiments with the laser are the main activities of the electronics group. Two major modifications of the laser chain are described. The installation of two synchronous oscillators at 1.06 and 1.053 micrometers is discussed. The replacement of two amplifier heads with linear flashes by two amplifier heads with helical flashes is described. ESA

N92-22959# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
ACTIVITIES OF THE LASER GROUP [ACTIVITE DE GROUPE LASER] **c36**
Ji-Ping Zou, Anne-Marie Tournade, and Sylvain Savalle *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 228-231 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

The 4300 firings of the laser at targets carried out during 1990 are summarized. More than half of these firings are at high flux. The impulse length of the laser has remained unchanged varying between 300 ps and 30 ns. Wavelengths corresponding to the first, second, and fourth harmonics of the laser emission are the mode. A maximum energy of 120 joules is available with the laser. ESA

N92-22960# Ecole Polytechnique, Palaiseau (France). Lab. pour l'Utilisation des Lasers Intenses.
LASER BIFREQUENCY [LASER BIFREQUENCE]
Francois Amiranoff, Michel Laberge, Jean-Raphael Marques, Sylvain Savalle, Anne-Marie Tournade, and Ji-Ping Zou *In its* The Laboratory for the Use of High-Energy Lasers May 1991 p 232-236 In FRENCH (For primary document see N92-22918 13-75)
Avail: NTIS HC/MF A12

Two short synchronized laser pulses are needed to create wave beating in plasma. The pulses need to be of close wavelengths and of maximum energy. A system involving two synchronous amplified oscillators is described. The placing of these oscillators is shown in diagrammatic form. The characteristics of the impulses produced and preamplification aspects are described. ESA

N92-23112# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Engineering Energie- und Anlagentechnik.
EVOLUTION OF ALPHA-PARTICLE DISTRIBUTION IN BURNING PLASMAS INCLUDING ENERGY DEPENDENT ALPHA-TRANSPORT EFFECTS Final Report
Gerald Kamelander, Dieter Sigmar (Massachusetts Inst. of Tech., Cambridge.), and Franz Woloch Sep. 1991 154 p Sponsored by Oesterreichischen Nationalbank
(OEFZS-4593; ETN-92-91105) Copyright Avail: NTIS HC/MF A08

The essential results of a project to investigate fusion alpha transport are summarized. A computer code, which makes use of the assumption that the fusion products give their energy to the plasma in the area where they are born, was developed. The

present transport code allows the calculation of the alpha distribution function. By making use of the distribution function, the energy deposition rates are calculated. The time evolution of the alpha distribution function was evaluated for an ignited plasma. A description of the transport code, the subroutines, and the input data is presented. Additionally, a listing is provided. ESA

N92-22365*# Sverdrup Technology, Inc., Brook Park, OH.
A COMPARISON OF TWO PLASMA MODELS
Russell Cottam *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 680-689 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20I

N92-22368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ION COLLECTION FROM A PLASMA BY A PINHOLE
David B. Snyder and Joel L. Herr (Sverdrup Technology, Inc., Cleveland, OH.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 694-702 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20I

N92-22369*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EXPERIMENTAL BREAKDOWN OF SELECTED ANODIZED ALUMINUM SAMPLES IN DILUTE PLASMAS
Norman T. Grier and Stanley Domitz *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 703-709 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20I

N92-22373*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CURRENT FLOW IN A PLASMA CAUSED BY DIELECTRIC BREAKDOWN
J. A. Vaughn, M. R. Carruth, Jr., and P. A. Gray (Sverdrup Technology, Inc., Huntsville, AL.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 724-731 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF A17 CSCL 20I

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-22159 Stanford Univ., CA.
PULSED LASER INDUCED EPITAXY Ph.D. Thesis
Yih Chang 1991 102 p
Avail: Univ. Microfilms Order No. DA9206748

Investigation of the interaction of pulsed mu V-laser beams with materials is being extensively studied due to potential applications. These include, for example, gas immersion laser doping, laser annealing of implantation damage, and fabrication of thin film superconductors by mu V-laser ablation. In this thesis, we introduce a new epitaxial growth technique based upon a pulsed mu V-laser melt-recrystallization process. This process, known as pulsed laser induced epitaxy (PLIE), is based on planar epitaxial regrowth from the underlying substrate following pulsed laser melting of the overlayers. The characteristic approximately 100 nanosecond time scale melt-solidification period, combined with localized melting allows integration of the technique into existing semiconductor processes with potential contributions to IC fabrication. Three current studies will be discussed in this work: pulsed laser annealing of implanted Ga impurities in SiC, heteroepitaxial In(sub x)Ga(sub 1-x)As/n(+)-GaAs(100) layer formation, and patterned Ge(sub x)Si(sub 1-x)/Si layers fabricated by PLIE. During the characterization of the redistribution of Si dopant species present in GaAs along with Ga, As, and In in the In(sub x)Ga(sub 1-x)As/n(+)-GaAs(100) layers formed by PLIE, we discovered an anomalous fast diffusion effect. It is found that significant diffusion, of which the enhancement is estimated to be nine orders of the magnitude higher than normal, occurs during the nanosecond time-scale processing duration. Although there are several possible electrical field effect phenomena existing during the melt duration, a hypothesis based upon a high temperature gradient induced fast diffusion is proposed to explain this behavior in both GaAs and Si semiconductors. In order to establish the proposed hypothesis, we developed an experiment, using dislocations and stacking faults with controlled size and shape to serve as markers, to allow for the investigation of this high temperature gradient field diffusion effect in Si substrates. The curved and expanded dislocation loop reveals that a significant diffusion and climb process has occurred during the pulsed melting process. A diffusion equation coupled with the Seebeck effect is then used to simulate the dislocation movement. The simulated profiles are in good agreement with transmission electron microscope (TEM) observations and lend further support to the hypothesis that high temperature gradient induced fields are the dominant effect responsible for the fast diffusion phenomena.
Dissert. Abstr.

N92-22206# Duke Univ., Durham, NC. Dept. of Chemistry.
REACTIONS OF GaX3 (X = BR, I) WITH As(SiMe3)3; CRYSTAL STRUCTURES OF I3Ga*As(SiMe3)3 AND (I2GaAs(SiMe3)2)2
James D. Johansen, Andrew T. McPhail, and Richard L. Wells 10 Dec. 1991 26 p
(AD-A243485; DU/DC/TR-25) Avail: NTIS HC/MF A03 CSCL 07/3

Since our introduction in 1986 of the use of the silyl halide elimination reaction for forming the Gallium Arsenide bond, we have found it to be a versatile tool for the synthesis of interesting compounds. Using reagents of the general form RnAs(SiMe3)(3-n) and R'nGaX(3-n) (n = 0, 1, 2), a number of monomeric, dimeric, trimeric, and mixed bridge arsinogallanes have been prepared. However, some of the most basic chemical reactions in this series, viz. those between As(SiMe3)3 and GaX3, remained largely unexplored. Previously, we reported that reaction of GaX3 (X = Chlorine, Bromine) and As(SiMe3)3 in a 1:1 mole ratio yields products which, upon being heated with a cool flame, give microcrystalline GaAs. Others have shown that GaAs made in this way consists of particles small enough to be expected to exhibit quantum confinement effects. GRA

N92-22323 Northwestern Univ., Evanston, IL.
MICROMECHANICS OF SOME SURFACE AND INTERFACE RELATED PROBLEMS Ph.D. Thesis
Shaowen Qin 1991 99 p
Avail: Univ. Microfilms Order No. DA9129055

Micromechanical behavior of near surface defects in a semi-infinite crystal lattice is investigated using a modified lattice theory, which was developed by extending the eigenstrain concept into the classical lattice theory. General discussion is given based on the Green's function method. It is proved that differences between lattice and continuum solutions exist only in a small neighborhood of the the defect. A local numerical method is proposed which shows through two examples that it is a simple and effective scheme regardless of the geometry where the problem is defined. An eigenstrain formulation is developed and applied to treat pre-existing defects in thin plates. Using the Eshelby solution, an elliptic inhomogeneity under uniform applied load can be made equivalent to that of an elliptic inclusion with appropriate uniform eigenstrain, and can therefore be solved readily. Micro-void nucleation at the interface between a thin film and a substrate under cyclic fatigue loading is discussed through a dislocation pile-up model. The accumulation of dislocation dipoles is calculated by solving an integral equation. It is shown that the total free energy of the system increases with the fatigue cycle number due to the increase in elastic strain energy, and that there exists a

critical fatigue cycle number beyond which the initial state of dislocation dipole accumulation becomes energetically unstable, so that the energy of this state will be released by the formation of a micro-void at the interface. The study can not only provide the S-N curves for initiation but also their dependence on material parameters. The coalescence of such micro-voids is expected to be an important mechanism of delamination of a thin film from its substrate. Dissert. Abstr.

N92-22675# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.

MOESSBAUER EFFECT IN CONFINED LIQUID MOLECULES

J. Hietaniemi, E. Ikonen, T. Katila, J. Linden, and I. Tittonen Mar. 1991 37 p

(PB92-141837; TKK-F-A680; ISBN-951-22-0559-9) Avail: NTIS HC/MF A03 CSCL 20L

Experimental and theoretical studies on the Sn-119 Mossbauer effect in SnCl4 molecules confined in porous glass are presented. A physical model, based on the assumption that diffusion is hindered in the pores, is developed. It is further assumed that the molecules in each pore form a harmonic lattice with fixed boundary conditions. The thermal vibration amplitudes of the particles are calculated by using a normal-mode expansion satisfying the fixed boundary conditions. It is rigorously shown that the transformation diagonalizes the Hamiltonian of the system, allowing subsequent use of standard calculational methods to derive expressions for the recoilless fraction and the second order Doppler shift in restricted geometry. The results allow evaluation of these quantities for molecules at different sites in the lattice. Experiments were made with two Vycor glass carriers at several temperatures below and above the 240 K freezing point of bulk SnCl4. The samples have average pore diameters of 40 A and 36 A. Mossbauer data of confined SnCl4 reveal a novel resonance line shift corresponding to the solid-liquid transition. This change in isomer shift is attributed to volume expansion of SnCl4 at its melting point. The measured temperature dependence of the recoilless fraction of the confined SnCl4 molecules is explained by the theoretical model. GRA

N92-22736# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.

MAGNETIC MODULATION OF MOESSBAUER RESONANCE IN THE PRESENCE OF STATIC LEVEL SPLITTING

J. Hietaniemi, E. Ikonen, T. Katila, and I. Tittonen Mar. 1991 41 p

(PB92-141845; TKK-F-A681; ISBN-951-22-0560-2) Avail: NTIS HC/MF A03 CSCL 20L

Studies on the possibility to observe nuclear magnetic resonance and Mossbauer resonance simultaneously are presented. The model system investigated consists of a nucleus with two separate excited state sublevels and an unsplit ground state. Furthermore, the excited state sublevels are modulated by an alternating magnetic field. Two theoretical models are presented. The first approach is a time domain extension of the density matrix theory recently presented by Salkola and Stenholm, and the other is based on the concept of phase modulation of gamma radiation. In addition to expressions of the conventional time averaged Mossbauer spectra, formulae for the time dependence of transmission intensity are derived for the three level model system. Results of the two approaches are compared with each other. Experiments are carried out using the 93.3 kilo-eV Mossbauer resonance of Zn-67. Energy levels of Zn-67 nuclei in the (67)ZnGaO single crystal source are split with a direct current magnetic field, and the system is exposed to an alternating current magnetic field with a frequency of 8.5 kilo-Hz and an amplitude of 23.3 mT. Static magnetic fields were between zero and 2 mT. The dynamics of the nuclear levels is studied by measuring the time dependence of the gamma radiation transmitted through a resonant (67)ZnO absorber. The data reveal that as the direct current field is increased, transmission curves exhibit distinct changes. The features in the experimental data are not reproduced by the theoretical models. GRA

N92-22738# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.

VORTEX LATTICE-VORTEX LIQUID STATES IN ANISOTROPIC HIGH-(T SUB c) SUPERCONDUCTORS

B. I. Ivlev, N. B. Kopnin, and M. M. Salomaa 1990 20 p Sponsored by Suomen Akatemja, Helsinki, and Akad. Nauk SSSR, Moscow

(PB92-142421; TKK-F-A668) Avail: NTIS HC/MF A03 CSCL 20L

The authors investigated vortex lattice structures in highly anisotropic superconductors for a situation where the vortices are slightly inclined with respect to the easy plane of the crystal. The equilibrium configuration is found to be a vortex lattice with a rhombic unit cell highly compressed along the direction perpendicular to the easy plane. The elastic modulus for a shear deformation along this direction is exponentially small, which should result in melting of the vortex lattice already at quite low temperatures. The authors discuss the implications of the theoretical results for experiments on the magnetization and on the angular dependence of the torque for anisotropic high T(sub c) superconductors in an applied magnetic field. GRA

N92-22973# EG and G Energy Measurements, Inc., Goleta, CA.

EFFECT OF HgI2 CRYSTAL NONUNIFORMITIES ON GAMMA RAY RESPONSE

K. James, V. Gerrish, E. Cross, J. Markakis, D. Nason, J. Marschall, and F. Milstein (California Univ., Santa Barbara.) 1991 39 p Presented at the 7th International Workshop on Room Temperature-Semiconductor X-ray and Gamma-ray Detectors and Associated Electronics, Ravello (Italy), 23-28 Sep. 1991

(Contract DE-AC08-88NV-10617)

(DE92-006797; EGG-10617-2100; CONF-9109209-1) Avail: NTIS HC/MF A03

As-grown HgI(sub 2) crystals exhibit regions of varying optical clarity indicative of varying defect density within the crystal bulk. It has been reported in the past that the resolution available from HgI(sub 2) gamma ray detectors is affected by these variations in crystallinity. The work reported here is a study correlating the crystallinity and impurity variations of large-area detector slices with gamma response variations. It was found that regions of higher optical clarity exhibit a 'dead layer' at their surface that reduces the amplitude of their low energy gamma response peak. The hole lifetime is longer and the high energy gamma resolution better, however, in the regions that contain fewer optically visible defects. Chemical and structural analysis of the different crystal regions was done. Impurity content was not found to correlate directly with optical clarity nor were major variations in stoichiometry apparent between regions of different optical density. Microhardness measurements indicate that the clear regions exhibit a significantly higher Knoop microhardness than optically hazy regions. DOE

N92-23118# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.

RESEARCH ON THE STRUCTURAL AND ELECTRONIC PROPERTIES OF DEFECTS IN AMORPHOUS SILICON

R. A. Street (Xerox Palo Alto Research Center, CA.) Dec. 1991 52 p

(Contract DE-AC02-83CH-10093)

(DE92-001177; NREL/TP-214-4591) Avail: NTIS HC/MF A04

The work performed for this contract focused on the saturation of light-induced effects, hydrogen-mediated metastability and growth, defects and electronic properties, and remote hydrogen plasma growth. This work included research on hydrogen chemical reactions, hydrogen density-of-states model and metastability, hydrogen bonding configurations, a model for the role of hydrogen complexes in the metastability, and hydrogen chemical potential and growth structure. This document also covers research on thermal generation currents in p-i-n diodes, field dependence of the generation current, metastability effects at contacts, and potential fluctuations in compensated a-Si:H. Information is included on plasma diagnostics using electron spin resonance and nuclear

magnetic resonance measurements of remote hydrogen plasma films. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-22137 Washington Univ., Seattle.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE THERMODYNAMICS OF THE THERMALLY CHOKED RAM ACCELERATOR Ph.D. Thesis
Carl Knowlen 1991 138 p
Avail: Univ. Microfilms Order No. DA9131665

A Hugoniot analysis of the quasi-one-dimensional ram accelerator propulsive modes is presented which relates the thermodynamic properties of the stationary propellant gas to the end state conditions that exist after projectile passage. The quasi-steady theoretical approach determines the differences between the inlet and outlet properties of a supersonic propellant gas that enters a control volume with a specified mass and momentum flux, and then leaves the control volume with the same mass flux, a new chemical composition, and a different momentum flux. Regions of potentially accessible thermodynamic end states were identified, which indicates that there are no fundamental reasons why a properly shaped projectile cannot operate at or above the Chapman-Jouguet (C-J) detonation velocity. The velocity and acceleration histories predicted by the Hugoniot analysis for the thermally choked ram accelerator cycle are shown to correlate well with experiments. Theoretical prediction for the pressure at the thermal chocking point match the tube wall pressure data, collected from behind the combustion zone at the projectile base, up to the C-J velocity of the propellant mixture. Good agreement between theory and experiments strongly supports the assumption that projectiles are accelerated with a thermally choked propulsive cycle while they are operating in the subdetonative velocity regime. Dissert. Abstr.

N92-22138 Boston Univ., MA.
INVERSE PROBLEMS AND ANTIDIFFUSION Ph.D. Thesis
Constantin S. Konstantopoulos 1992 140 p
Avail: Univ. Microfilms Order No. DA9130710

A new set of parametric wavelets called Hermite-Rodriguez wavelets, and a new family of highly singular functions called hyperdistributions are introduced. Their introduction is motivated by the search for a consistent solution to the inverse problem in signals and systems analysis: the evaluation of the initial conditions or input to a system, given its final condition or output and its impulse response. I construct a novel mathematical framework for the search for a solution to the inverse problem, and apply it to a practical case: the inverse problem for blurring systems. The mathematical equivalent for the solution to the inverse problem for blurring systems is given. It consists of solving the antidiffusion equation, which is equivalent to solving the diffusion equation backwards in time, to determine the initial conditions of the diffusive process, given the final condition. I apply this solution of the inverse problem to two practical cases: the reconstruction of blurred signals, and of blurred simulated astronomical images. Dissert. Abstr.

N92-22247# Texas Univ., Austin.
A PRIORI CALCULATION OF THERMODYNAMIC FUNCTIONS Ph.D. Thesis
Floyd R. Cordell Dec. 1991 223 p
(Contract N00123-89-G-0531)
(AD-A245055) Avail: NTIS HC/MF A10 CSCL 12/1

A method for calculating a priori thermodynamic functions (specific heat, entropy, free energy, and enthalpy) from a combination of single determinant ab initio calculations employing the 4-21NO basis and experimental data is developed and validated. An estimate of the r sub e geometry is determined by empirically correcting the optimized 4-21NO ab initio geometry with formulae derived from carefully selected experimental r sub e, r sub s, and r sub g geometries for errors caused by basis set truncation and neglect of electron correlation. The r sub e geometry is then used as the reference geometry for the calculation of the ab initio force field by the finite difference method. The Scaled Quantum Mechanical force field is calculated from the ab initio force field using a standard set of scale factors. Fundamental vibration frequencies derived from Scaled Quantum Mechanical force field usually agrees to within 15 cm-1 of the corresponding experimental fundamental vibration frequencies. Rotational constants derived from the r sub e geometry, Scaled Quantum Mechanical fundamental vibration frequencies, and molecular weight are used as inputs for calculating thermodynamic functions via standard statistical mechanic methods, invoking the Born-Oppenheimer and rigid rotor harmonic oscillator approximations. The heat of formation at 0 K, E sub 0 is calculated either via a method based on atomic equivalents of a method based on isodesmic reactions. GRA

N92-22975# Kyoto Univ., Uji (Japan). Inst. for Theoretical Physics.
NON-PERTURBATIVE EFFECT OF A MODIFIED ACTION IN MATRIX MODELS
Shiro Sawada and Haruhiko Ueda May 1991 10 p
(DE92-750832; YITP/U-91-24) Avail: NTIS HC/MF A02

A modified matrix model action, which may provide the well-defined two dimensional pure gravity theory, proposed by Das, Dhar, Sengupta and Wadia is analyzed non-perturbatively. The perturbative solution in genus expansion is also obtained. It is shown that the specific heat satisfies Painleve equation in the double scaling limit. Thus the modified action is found to be in the same universality class as ordinary matrix models. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N92-22101# Technische Univ., Eindhoven (Netherlands). Dept. of Mathematics and Computing Science.
SUPPORT FOR PROBLEM FORMULATION AND EVALUATION IN MANPOWER PLANNING PROBLEMS
M. W. I. vanKraaij, W. Z. Venema, and J. Wessels Jan. 1991 14 p
(Memo-COSOR-91-02; ETN-92-91170) Avail: NTIS HC/MF A03

A system to support a manpower planner in the decision making process is developed. The functional structure of this system consists of two main components. One component, the problem solver, generates the consequences during the planning period of specified problem situations. The other component, the problem interpreter, is responsible for the communication of the planner with the system. The last component is focused upon. The problem interpreter must support a planner in a rather active way in the formulation of the problem situations and in the evaluation of their consequences, generated by the system. So, from the actions that take place in the communication of the planner with the system a set of tasks that must be provided by the problem interpreter are obtained. ESA

N92-22111# Technische Univ., Eindhoven (Netherlands). Dept. of Mathematics and Computing Science.
SOME CONSIDERATIONS CONCERNING THE PROBLEM INTERPRETER OF THE NEW MANPOWER PLANNING SYSTEM FORMASY
M. W. I. vanKraaij, W. Z. Venema, and J. Wessels Jan. 1991 12 p
(Memo-COSOR-91-04; ETN-92-91171) Avail: NTIS HC/MF A03

The difficulties that arise and the choices that have to be made in the development of the problem interpreter, the component of the manpower planning system that is responsible for the communication with the planner, are considered. The tasks of the interpreter can be classified in: conversion and representation; evaluation; verification. The format of the formal specification and the considerations that play a role in the choice for this format are considered. The several presentation possibilities that determine the format of the informal specification are considered. Some consequences of these choices for the conversion of informal to formal specification and vice versa are also considered and some general remarks concerning the evaluation are made. ESA

N92-22175# Naval Postgraduate School, Monterey, CA.
A MODEL PROCEDURE INTEGRATING TOTAL QUALITY MANAGEMENT INTO THE SOURCE SELECTION PROCESS M.S. Thesis
Richard L. Wilson Jun. 1991 119 p
(AD-A245061) Avail: NTIS HC/MF A06 CSCL 05/1

An attempt to construct and refine a model procedure for DoD contracting activities is presented. The model is to be utilized when integrating quality factors such as Total Quality Management into the source selection process for major acquisitions. The primary objective of this thesis was to modify application guidelines for the Malcolm Baldridge Quality Award into source selection criteria, and then devise a procedure to temper the results of the basic proposal evaluation with a degree of risk determined from a Performance Risk Assessment of the offeror. A secondary objective of this thesis was to construct the model's algorithm in a manner which will offer maximum flexibility to contracting agencies to tailor any aspects of the procedure to fit local requirements, regulations, and standard operating procedures. The final objective of this thesis was to obtain feedback from knowledgeable and experienced Government contracting or policy personnel, and to modify or refine the procedure into a more feasible, useful model. GRA

N92-22229 Politecnico di Milano (Italy). Dipartimento di Elettronica.
APPLYING TABU-SEARCH TO THE JOB-SHOP SCHEDULING PROBLEM
Mauro DellAmico and Marco Trubian 1991 24 p Sponsored in part by Italian Ministry of Public Education and Italian Ministry of University and Scientific Research
(Rept-91-052; ETN-92-91185) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The Tabu-Search technique is applied to the Job-Shop Scheduling problem, a notoriously difficult problem in combinatorial optimization. It is shown that the implementation of this method improves both a previous approach with Tabu-Search and the other heuristics based on iterative improvements. ESA

N92-22646*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TQM: A BIBLIOGRAPHY WITH ABSTRACTS
Gretchen L. Gottlich, ed. Apr. 1992 207 p
(NASA-TM-104204; NAS 1.15:104204) Avail: NTIS HC/MF A10 CSCL 05A

This document is designed to function as a special resource for NASA Langley scientists, engineers, and managers during the introduction and development of total quality management (TQM) practices at the Center. It lists approximately 300 bibliographic citations for articles and reports dealing with various aspects of TQM. Abstracts are also available for the majority of the citations. Citations are organized by broad subject areas, including case studies, customer service, senior management, leadership, communication tools, TQM basics, applications, and implementation. An introduction and indexes provide additional information on arrangement and availability of these materials. Author

N92-22665* National Aeronautics and Space Administration, Washington, DC.
CONTINUOUS IMPROVEMENT: A BIBLIOGRAPHY WITH INDEXES, 1989-1991
Feb. 1992 59 p
(NASA-SP-7097; NAS 1.21:7097) Avail: NTIS HC A04 CSCL 05A

This bibliography contains 198 annotated references to reports and journal articles entered into the NASA Scientific and Technical Information Data base during 1989 to 1991. Author

N92-22343*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
TIME MANAGEMENT DISPLAYS FOR SHUTTLE COUNTDOWN
Arthur E. Beller, H. Greg Hadaller, and Mark J. Ricci (Boeing Aerospace Co., Kennedy Space Center, FL.) *In* NASA. Johnson Space Center, 5th Annual Workshop on Space Operations Applications and Research (SOAR 1991), Volume 2 Feb. 1992 p 546 (For primary document see N92-22324 13-59)
Avail: NTIS HC/MF Â17 CSCL 05A

N92-22710*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INCREASING PRODUCTIVITY THROUGH TOTAL REUSE MANAGEMENT (TRM)
M. P. Schuler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 294-300 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 05A

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-22108*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SPACE TRANSPORTATION SYSTEM AND ASSOCIATED PAYLOADS: GLOSSARY, ACRONYMS, AND ABBREVIATIONS
Jan. 1992 208 p Prepared in cooperation with NASA- John F. Kennedy Space Center, Cocoa Beach, FL and NASA- Lyndon B. Johnson Space Center, Houston, TX
(NASA-TM-103575; NAS 1.15:103575) Avail: NTIS HC/MF A10 CSCL 05B

A collection of some of the acronyms and abbreviations now in everyday use in the shuttle world is presented. It is a combination of lists that were prepared at Marshall Space Flight Center and Kennedy and Johnson Space Centers, places where intensive shuttle activities are being carried out. This list is intended as a guide or reference and should not be considered to have the status and sanction of a dictionary. Author

N92-22131# Information Resources Management Service, Vienna, VA.
MANAGING INFORMATION RESOURCES FOR ACCESSIBILITY
Dec. 1991 154 p
(PB92-129154) Avail: NTIS HC/MF A08 CSCL 05B

General Services Administration's (GSA's) Information Resource Management (IRM) Service is working with other agencies to provide information environments that are accessible by people with disabilities. The handbook discusses how to integrate

information accessibility into the overall IRM process. The primary audience for the publication is IRM managers and program managers in the Federal government who want to understand how to respond to accessibility needs of Federal personnel and the public. The handbook consists of four parts: introduction to information accessibility; how to incorporate accessibility into agency practice; the types of accommodation products available to achieve access; and appendices. The appendices add a level of detail that will be needed primarily by personnel responsible for integrating access practices into technical support services. GRA

N92-22143# National Inst. of Standards and Technology, Gaithersburg, MD.
DEVELOPMENT OF AN OPTICAL DISK SYSTEM FOR THE AUTOMATED RETRIEVAL OF EASEAR RECORDS Final Report
N. Willman Aug. 1991 139 p
(PB92-108943; NISTIR-4654) Avail: NTIS HC/MF A07 CSCL 08B

The Social Security Administration (SSA) maintains records of the yearly wages earned by every person in the United States. Each year, approximately 2.5 gigabytes of data are collected on self-employed wage earners, and 47 gigabytes of data are collected on other wage earners. The records are currently stored on over 110,000 rolls of microfilm. It takes over 400 scouts to retrieve information needed by the professional staff. Often, the needed roll of film is missing from the file due to being currently in use, misfiled, or misplaced. In addition, the information obtained from the microfilm is not always the most current, and decisions are sometimes based on obsolete data. Advances in peripheral mass storage technology during the 1980s (e.g. magneto-optic recording) now allow for alternate approaches to data storage and retrieval. It is believed that an automated retrieval system would provide a more accurate, timely, and cost effective means of retrieving information. The pilot application detailed in the document is intended to demonstrate the feasibility of a full scale automated records retrieval system, to study the impact of an automated system on the users, and to gain insight into the factors which would impact the design of a full scale system. Author

N92-22145 Rutgers - The State Univ., New Brunswick, NJ.
ONLINE SEARCH STRATEGY MODIFICATION BY END USERS Ph.D. Thesis
Wagih A. Shenouda 1991 371 p
Avail: Univ. Microfilms Order No. DA9200271

The study investigated how users interact with an information retrieval (IR) system in a natural environment. The focus was on identifying the processes by which end users modify their initial search strategies in the light of new information presented during the online process. Also examined was the effectiveness of such modification in retrieving relevant documents. Characteristics associated with end users' search behavior were identified. The aim was to explore possible relationships between a number of variables associated with users' problematic situation and the search process and outcome. The major findings indicate that the users modified their search strategy during interaction with the system. Categories of actions for modification, as well as categories of reasons for invoking such actions were developed and identified in each search. The actions most frequently taken were associated with the deletion and addition of terms and facets. Reasons for invoking these changes were mainly related to relevance decisions. Dissert. Abstr.

N92-22508* National Aeronautics and Space Administration, Washington, DC.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS (SUPPLEMENT 40)
Jan. 1992 81 p
(NASA-SP-7039(40)-Sect-1; NAS 1.21:7039(40)-Sect-1) Avail: NTIS HC A05; NTIS standing order as PB92-911100, A03 CSCL 05B

Abstracts are provided for 181 patents and patent applications entered into the NASA scientific and technical information system during the period July 1991 through December 1991. Each entry consists of a citation, an abstract, and in most cases, a key illustration selected from the patent or patent application. Author

N92-22544# Advanced Sciences, Inc., Arlington, VA.
CONSERVATION AND RENEWABLE ENERGY INQUIRY AND REFERRAL SERVICE
1991 14 p
(Contract DE-AC01-86CE-35000)
(DE92-006575; DOE/CE-35000/T1) Avail: NTIS HC/MF A03

During the past 5 years, the Conservation and Renewable Energy Inquiry and Referral Service (CAREIRS) developed into a highly utilized information service, serving the information needs of homeowners, small businesses, community groups, libraries, and the educational sector. CAREIRS also responded to increasing numbers of DOE controlled correspondence. CAREIRS was successfully able to inform the general public about energy conservation and renewable energy technologies, thus meeting the goals of the project. Quality and timely information was expeditiously produced and delivered on a wide variety of related energy topics. Moreover, through an automated system, we were able to maintain, organize and update statistical information, as well as information on the technologies. Significant changes occurred during the life of this contract. During the Base Year, in 1986, Advanced Sciences, Inc. (ASI) managed publications development, response activities, and intermediary networking, and Franklin Research Center (FRC) provided subcontractor support in the key areas of data base maintenance, telephone response activities, and library management, from its offices in Philadelphia, PA. On July 1, 1987, ASI became sole CAREIRS contractor and consolidated all project operations in the Washington, DC area. ASI set up the toll-free hotline and energy library in its Arlington, VA office, converted the automated inquiry response system from a mainframe to an in-house microcomputer environment, and automated the library catalog system onto the microcomputer system. The transition occurred smoothly with no major disruptions; requests were answered during the transition within the time allowed by the contract. Following a reorganization in 1989, management of CAREIRS was transferred from the Office of Renewable Energy to the newly-formed Office of Technical and Financial Assistance. DOE

N92-22608 Brunel Univ., Uxbridge (England).
RESEARCH INTO SOME STRATEGIC FACTORS IN THE MARKETING OF INFORMATION TECHNOLOGY TOWARDS THE 21ST CENTURY Ph.D. Thesis
Laurence Stanley Lyons 1990 419 p
Avail: Univ. Microfilms Order No. BRDX93531

The factors influencing the marketing of information technology are identified and explored. Initial research uncovered certain problems and current frustrations in the theory and practice of management science - a discipline that sets the context for this research. In order to address these theoretical and philosophical challenges, an extremely comprehensive model of strategic organizational analysis is presented. The model has many novel and attractive characteristics. It is constructed from first principles; it can handle ambiguity in terms of alternative boundary definitions; and it recognizes conflict that stems from unresolved issues in the stakeholder context of the organization. Notes from case studies are included to demonstrate how the resulting model has been used in practical applications. Dissert. Abstr.

N92-22663*# National Aeronautics and Space Administration, Washington, DC.
QUO VADIMUS? THE 21ST CENTURY AND MULTIMEDIA
Allan D. Kuhn Nov. 1991 18 p
(NASA-TM-107563; NAS 1.15:107563) Avail: NTIS HC/MF A03 CSCL 05B

The concept is related of computer driven multimedia to the NASA Scientific and Technical Information Program (STIP). Multimedia is defined here as computer integration and output of text, animation, audio, video, and graphics. Multimedia is the stage

of computer based information that allows access to experience. The concepts are also drawn in of hypermedia, intermedia, interactive multimedia, hypertext, imaging, cyberspace, and virtual reality. Examples of these technology developments are given for NASA, private industry, and academia. Examples of concurrent technology developments and implementations are given to show how these technologies, along with multimedia, have put us at the threshold of the 21st century. The STI Program sees multimedia as an opportunity for revolutionizing the way STI is managed.
Author

N92-22664*# National Aeronautics and Space Administration, Washington, DC.
THE NASA SCIENTIFIC AND TECHNICAL INFORMATION PROGRAM: PROLOGUE TO THE FUTURE
1991 50 p Original contains color illustrations
(NASA-TM-107814; NAS 1.15:107814) Avail: NTIS HC/MF A03; 6 functional color pages CSCL 05B

The NASA STI Program offers researchers an infrastructure of people and systems that facilitates access to STI; worldwide. The Program is also NASA's institutional mechanism for disseminating the results of its research and developing activities. Through discussions in 1991, the STI Program formulated its Strategic Plan. The plan gives the Program a renewed sense of direction by focusing on future opportunities, customer requirements and Program goals, along with the changes needed to achieve those goals. The Program provides users access to a massive flow of STI which, in fact, represents the largest collection of aeronautical and space science information in the world. The STI Program products and services are outlined, along with the NASA centers, international operations, and the fact that total quality management drives NASA wide program developments. As is detailed, the NASA STI Program is using its resources as effectively as possible to meet the missing needs of NASA.
Author

N92-22968*# National Aeronautics and Space Administration, Washington, DC.
NACA DOCUMENTS DATABASE PROJECT Final Report
Ruth S. Smith Apr. 1991 99 p
(NASA-TM-107766; NAS 1.15:107766) Avail: NTIS HC/MF A05 CSCL 05B

The plan to get all the National Advisory Committee on Aeronautics (NACA) collection online, with quality records, led to the NACA Documents Data base Project. The project has a two fold purpose: (1) to develop the definitive bibliography of NACA produced and/or held documents; and (2) to make that bibliography and the associated documents available to the aerospace community. This study supports the first objective by providing an analysis of the NACA collection and its bibliographic records, and supports the second objective by defining the NACA archive and recommending methodologies for meeting the project objectives.
Author

N92-22472*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ADVANCED TECHNIQUES AND TECHNOLOGY FOR EFFICIENT DATA STORAGE, ACCESS, AND TRANSFER
Robert F. Rice (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Warner Miller *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 429-435 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05B

N92-22475*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SILVABASE: A FLEXIBLE DATA FILE MANAGEMENT SYSTEM
Steven J. Lambing and Sandra J. Reynolds (Boeing Computer Support Services, Inc., Huntsville, AL.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 451-460 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05B

N92-22742*# Gates Aerospace Batteries, Gainesville, FL.
PROFILE OF A CELL TEST DATABASE AND A CORRESPONDING RELIABILITY DATABASE
George R. Brearley and Glenn C. Klein *In* NASA. Marshall Space Flight Center, The 1991 NASA Aerospace Battery Workshop Feb. 1992 p 27-35 (For primary document see N92-22740 13-44)
Avail: NTIS HC/MF A99 CSCL 05B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N92-22130# Quantum Research Corp., Bethesda, MD.
METHODOLOGICAL REPORT ON THE CONDUCT OF THE NATIONAL SCIENCE FOUNDATION'S SURVEY OF SCIENTIFIC AND ENGINEERING EXPENDITURES AT UNIVERSITIES AND COLLEGES, FY 1990
Dec. 1991 17 p
(PB92-120617) Avail: NTIS HC/MF A03 CSCL 05C

The report provides a summary description of the Research and Development (R&D) Expenditures Survey population, data collection and processing activities, response rates, and imputation for nonresponse. The fiscal year (FY) 1990 survey sample population consisted of 459 universities or colleges with over $50,000 in R&D expenditures and 18 academically administered federally funded research and development centers (FFRDCs).
GRA

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-22972# Department of Energy, Washington, DC.
TECHNOLOGY 1991
Jan. 1992 175 p
(DE92-004573; DOE/ER-0531P) Avail: NTIS HC/MF A08

This document, Technology '91, is the latest in a series that is intended to communicate some of the many opportunities available for US industry and universities to work with DOE and its laboratories in the vital activity of improving technology transfer to meet national needs. Technology '91 is divided into four sections: 'Access to the Laboratories,' 'Techniques,' 'Laboratories,' and 'DOE Offices.' The first section (Access) describes the many avenues for cooperative interaction between the DOE Laboratories and industry, academia, and other government agencies. The 'Technologies' section provides descriptions of new technologies developed at the DOE laboratories. The third section (Laboratories) contains profiles of each laboratory. These present information on missions, programs, and facilities, along with a technology transfer contact for additional information. The final section contains brief

descriptions of the major R & D Programs within the DOE. It also contains information on how to access DOE scientific and technical information. DOE

N92-22705*# Martin Marietta Corp., New Orleans, LA.
COMMERCIAL APPLICATION OF THERMAL PROTECTION SYSTEM TECHNOLOGY
Gordon L. Dyer *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 250-257 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 05A

88 SPACE SCIENCES (GENERAL)

N92-22610*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WORKSHOP PROCEEDINGS: SENSOR SYSTEMS FOR SPACE ASTROPHYSICS IN THE 21ST CENTURY, VOLUME 2
Barbara A. Wilson, ed. 1 Aug. 1991 86 p Workshop held in Pasadena, CA, 23-25 Jan. 1991 *Its* Astrotech 21 Series 3: Integrated Technology Planning Original contains color illustrations
(Contract NAS7-918)
(NASA-CR-189449; JPL-Publ-91-24-Vol-2; NAS 1.26:189449)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03A

In 1989, the Astrophysics Division of the Office of Space Science and Applications initiated the planning of a technology development program, Astrotech 21, to develop the technological base for the Astrophysics missions developed in the period 1995 to 2015. The Sensor Systems for Space Astrophysics in the 21st Century Workshop was one of three Integrated Technology Planning workshops. Its objectives were to develop an understanding of the future comprehensive development program to achieve the required capabilities. Program plans and recommendations were prepared in four areas: x ray and gamma ray sensors, ultraviolet and visible sensors, direct infrared sensors, and heterodyne submillimeter wave sensors. For individual titles, see N92-22611 through N92-22620.

N92-22611*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WORKSHOP PROCEEDINGS: SENSOR SYSTEMS FOR SPACE ASTROPHYSICS IN THE 21ST CENTURY Executive Summary c19
In its Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 1-3 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

This proceedings provides a summary of the Astrotech 21 Sensor Technology Workshop. Topics covered include: high energy sensors, ultraviolet and visible sensors, direct infrared sensors, heterodyne submillimeter wave sensors, sensor readout electronics, and sensor cooler technology. H.A.

N92-22612*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ASTROTECH 21 PROGRAM OVERVIEW Abstract Only c89
J. Cutts and J. Fordyce *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 1 Aug. 1991 2 p (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03A

This brief report describes the initiation and development of the Astrotech 21 Program. The scope of the included workshop discusses sensor technology and how this may be utilized in the overall scheme of the Astrotech 21 Program. H.A.

N92-22613*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE NEXT CENTURY ASTROPHYSICS PROGRAM c90
Paul N. Swanson *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 7-14 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03B

The Astrophysics Division within the NASA Office of Space Science and Applications (OSSA) has defined a set of major and moderate missions that are presently under study for flight sometime within the next 20 years. These programs include the: Advanced X Ray Astrophysics Facility; X Ray Schmidt Telescope; Nuclear Astrophysics Experiment; Hard X Ray Imaging Facility; Very High Throughput Facility; Gamma Ray Spectroscopy Observatory; Hubble Space Telescope; Lunar Transit Telescope; Astrometric Interferometer Mission; Next Generation Space Telescope; Imaging Optical Interferometer; Far Ultraviolet Spectroscopic Explorer; Gravity Probe B; Laser Gravity Wave Observatory in Space; Stratospheric Observatory for Infrared Astronomy; Space Infrared Telescope Facility; Submillimeter Intermediate Mission; Large Deployable Reflector; Submillimeter Interferometer; and Next Generation Orbiting Very Long Baseline Interferometer. H.A.

N92-22614*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SENSOR TECHNOLOGY WORKSHOP: STRUCTURE AND GOALS c19
Barbara A. Wilson *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 15-16 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

The Astrotech 21 charter for the second of three workshops is described. The purpose was to identify technology needs in the areas of electromagnetic radiation sensors, and to recommend a plan to develop the required capabilities that are not currently available. The panels chosen for this workshop focused specifically on those technologies needed for the Astrotech 21 Program including: gamma ray and x ray sensors, ultraviolet and visible sensors, direct infrared sensors, and heterodyne submillimeter wave sensors. H.A.

N92-22615*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REPORT OF THE X RAY AND GAMMA RAY SENSORS PANEL c89
Andrew Szymkowiak, S. Collins, J. Kurfess, W. Mahoney, D. McCammon, R. Pehl, and G. Ricker (Massachusetts Inst. of Tech., Cambridge.) *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 18-26 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03A

Overall five major areas of technology are recommended for development in order to meet the science requirements of the Astrotech 21 mission set. These are: detectors for high resolution gamma ray spectroscopy, cryogenic detectors for improved x ray spectral and spatial resolution, advanced x ray charge coupled devices (CCDs) for higher energy resolution and larger format, extension to higher energies, liquid and solid position sensitive detectors for improving stopping power in the energy range 5 to 500 keV and 0.2 to 2 MeV. Development plans designed to achieve the desired capabilities on the time scales required by the technology freeze dates have been recommended in each of these areas. H.A.

N92-22616*# Stanford Univ., CA.
REPORT OF THE ULTRAVIOLET AND VISIBLE SENSORS PANEL c19
J. Gethyn Timothy, M. Blouke, R. Bredthauer, R. Kimble, T.-H. Lee, M. Lesser, O. Siegmund, and G. Weckler (Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.) *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 27-33 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

In order to meet the science objectives of the Astrotech 21

mission set the Ultraviolet (UV) and Visible Sensors Panel made a number of recommendations. In the UV wavelength range of 0.01 to 0.3 micro-m the focus is on the need for large format high quantum efficiency, radiation hard 'solar-blind' detectors. Options recommended for support include Si and non-Si charge coupled devices (CCDs) as well as photocathodes with improved microchannel plate readouts. For the 0.3 to 0.9 micro-m range, it was felt that Si CCDs offer the best option for high quantum efficiencies at these wavelengths. In the 0.9 to 2.5 micro-m the panel recommended support for the investigation of monolithic arrays. Finally, the panel noted that the implementation of very large arrays will require new data transmission, data recording, and data handling technologies. H.A.

N92-22617*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
REPORT OF THE DIRECT INFRARED SENSORS PANEL c19
Craig McCreight, R. Bharat, R. Capps, W. Forrest, A. Hoffman, R. McMurray, H. Moseley, M. Reine, P. Richards, and D. Smith (Los Alamos National Lab., NM.) et al *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 34-49 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

The direct infrared sensors panel considered a wide range of options for technologies relevant to the science goals of the Astrotech 21 mission set. Among the technologies assessed are: large format arrays; photon counting detectors; higher temperature 1 to 10 micro-m arrays; impurity band conduction (IBC) or blocked impurity band (BIB) detectors; readout electronics; and adapting the Space Infrared Telescope Facility and Hubble Space Telescope. Detailed development plans were presented for each of these technology areas. H.A.

N92-22618*# Bell Telephone Labs., Inc., Holmdel, NJ.
REPORT OF THE HETERODYNE SUBMILLIMETER-WAVE SENSORS PANEL c19
Robert Wilson, G. Chin, T. Crowe, M. Feldman, M. Frerking, E. Kolberg, H. LeDuc, T. Phillips, F. Ulaby, and W. Wilson (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) et al *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 50-57 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

After reviewing the science goals of the Astrotech 21 mission set, and comparing the resulting receiver performance requirements with existing technology, the panel determined that there were significant unmet requirements in four areas: local oscillator power and mixer sensitivity in the Tera-Hz regime, infrared spectrometer channel count, and array technology in any form. A comprehensive development plan has been prepared to provide these capabilities in the time frame needed before technology freeze dates of the respective missions. It was also noted that development of these capabilities has immense payoff for future astrophysics missions, as it opens entire new areas of spectroscopy and imaging in the critical submillimeter wave regime rich in molecular transitions. H.A.

N92-22619*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPORT OF THE SENSOR READOUT ELECTRONICS PANEL c19
Eric R. Fossum, J. Carson, W. Kleinhans, W. Kosonocky, L. Kozlowski, A. Pecsalski, A. Silver, H. Spieler, and J. Woolaway (Amber Engineering Co., Goleta, CA.) *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 58-67 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

The findings of the Sensor Readout Electronics Panel are summarized in regard to technology assessment and recommended development plans. In addition to two specific readout issues, cryogenic readouts and sub-electron noise, the panel considered three advanced technology areas that impact the ability to achieve large format sensor arrays. These are mega-pixel focal plane packaging issues, focal plane to data processing module interfaces, and event driven readout architectures. Development in each of these five areas was judged to have significant impact in enabling the sensor performance desired for the Astrotech 21 mission set. Other readout issues, such as focal plane signal processing or other high volume data acquisition applications important for Eos-type mapping, were determined not to be relevant for astrophysics science goals. H.A.

N92-22620*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPORT OF THE SENSOR COOLER TECHNOLOGY PANEL c19
Ronald Ross, S. Castles, N. Gautier, P. Kittel, and J. Ludwigsen (Strategic Defense Initiative Organization, Washington, DC.) *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 68-80 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 14B

The Sensor Cooler Technology Panel identified three major areas in which technology development must be supported in order to meet the system performance requirements for the Astrotech 21 mission set science objectives. They are: long life vibration free refrigerators; mechanical refrigeration for 2 K to 5 K; and flight testing of emerging prototype refrigerators. A development strategy and schedule were recommended for each of the three areas. H.A.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-22163 California Inst. of Tech., Pasadena.
A MULTIWAVELENGTH OBSERVATIONAL INVESTIGATION OF HERBIG-HARO OBJECTS AND THEIR EXCITING STARS Ph.D. Thesis
Karl Roald Stapelfeldt 1991 175 p
Avail: Univ. Microfilms Order No. DA9137294

Herbig-Haro objects are small optical emission line nebulae, shock-heated by collimated winds from young stars. In this thesis, near infrared imaging and high resolution optical imaging spectroscopy have been used to investigate Herbig-Haro object shock structure. Four objects have been studied: HH 7-11, HH 12, HH 34, and HH 1. By a detailed comparison of emission line images and spatially complete kinematic maps, we find that although no single flow model can be applied to all regions, some regions do fit the existing models quite well. HH 7 is well-described as the working surface of a stellar jet, with both a bowshock and a jet terminus shock identified within it. The density of this jet is shown to be comparable to the density of the medium it is impacting. Based on the absence of 2 micron H2 line emission in the shocked wind material, H2 does not appear to be a major constituent of the outflowing winds. Where H2 emission is found, the associated (S 2) emission tends to have lower radial velocities. The 1.64 micron (Fe 2) emission line has been imaged for the first time in HH objects. The (Fe 2) images indicate extinction is not significant in determining the optical appearance of the HH objects studied, and thus the HH 34 bipolar outflow is indeed a one-sided jet system. The kinematics and H2 morphology of HH 12 argue for SVS 12 as this object's exciting star, a conclusion which strongly suggests that the observed proper motions in this object represent pattern motion rather than a material velocity. The second part of this work is a study of the circumstellar material of two HH object-exciting stars using millimeter-wave interferometry. High resolution CO-13 images suggest that the HH34 and HH 111 exciting stars both possess circumstellar disks elongated perpendicular to the highly collimated optical jets emerging from these two sources. The masses of these disks are two to four

times greater than the disk masses found for T Tauri stars, although the sizes are comparable. The stellar source masses are most likely less than 2 M solar magnitude. The total weight of evidence argues that HH exciting stars represent an earlier stage of stellar evolution than T Tauri stars, and that large disk masses are being accreted onto the central star, dispersed by the outflow winds, and/or formed into planets during the earliest phases of the life of a star. Dissert. Abstr.

N92-22255 Cornell Univ., Ithaca, NY.
PULSAR TIMING AT METER AND DECAMETER WAVELENGTHS Ph.D. Thesis
James Anthony Phillips 1991 147 p
Avail: Univ. Microfilms Order No. DA9203974

Decameter wavelength pulsar timing data are potentially sensitive to propagation effects which are difficult or impossible to detect at higher frequencies. These include refraction in the interstellar medium, ray bending in the pulsar magnetosphere, and magnetic sweepback near the pulsar light cylinder. To search for such effects, timing observations were made of eight nearby pulsars at multiple frequencies between 25 MHz and 4.8 GHz. Data obtained at 25 and 47 MHz were of unprecedented quality in terms of time resolution and signal to noise. It was found that pulse arrival times below approx. 1 GHz were proportional to nu(exp -2), as expected for group delays in the tenuous interstellar plasma. Terms in the dispersion law proportional to nu(exp -3) and nu(exp -4) (due to density clumping, magnetic fields, and refraction) were absent, even at 25 MHz. The absence of departures from the nu(exp -2) dispersion law places stringent constraints on radius to frequency mapping models of the pulsar emission mechanism. Observations at 47 and 430 MHz were conducted once a month over a two year period in order to monitor changes in the interstellar electron column density in the direction of seven pulsars.
Dissert. Abstr.

N92-22258 Washington Univ., Seattle.
CEPHEID ENVELOPE MODELS Ph.D. Thesis
Siobahn Mary Morgan 1991 327 p
Avail: Univ. Microfilms Order No. DA9203287

Models of Cepheid envelopes are constructed to examine their characteristics and compare them with observations. The models are initially in hydrostatic equilibrium and the mass luminosity relations of different stellar evolution calculations can be assigned groups of these models. A method for an explicit hydrodynamics and implicit radiative transfer solution to the pulsational variation of the Cepheid models is described. This method is applied to the same series of models to obtain light and velocity curves. In most cases the pulsational characteristics of the models are similar to the results obtained by the Linear Non-Adiabatic analysis. Thus, the models that correspond to the highest luminosity stellar evolution calculations give the best fit to empirical Cepheid relations. The same method of analysis described is also applied to a series of models that have opacities increased along the lines suggested by recent opacity calculations. In most cases, the model characteristics are similar to those for the models described. It is found that the models that best fit the empirical relations of Cepheids are those that correspond to the high luminosity stellar evolution calculations. Dissert. Abstr.

N92-22300# Ludwig-Maximilians-Univ., Munich (Germany, F.R.). Fakultaet fuer Physik.
GRAVITATIONAL MICROLENSING Thesis
Joachim Wambsganss 1 Aug. 1990 177 p
(ETN-92-91005) Avail: NTIS HC/MF A09

The phenomenon of gravitational microlensing, the gravitational lens effect of individual stars inside a lensing galaxy on the light rays of a background quasar, is investigated. The basics of gravitational lensing are given, and the current state-of-the-art in observations as well as in theory is summed up. The method used for the simulation of the gavitational light deflection is based on a hierarchical tree code which is optimized for the application in gravitational lensing, so almost one million individual stars could be used in the calculations. In addition to the standard ways of analysis, like magnification patterns, light curves, and magnification probabilities, the concept of percolation is applied to the resulting two-dimensional magnification distributions, as well as that of the fractal dimension of minimal spanning clusters. A large variety of numerical simulations is presented. Microlensing at (macro)caustics is investigated, and the large variety in morphology of gravitationally lensed images, which consist of very many micro-images, is shown. As an application, a microlensing model for image A of the quadruple quasar 2237+0305 is developed. Features in the resulting light curve similar to the one observed are easily reproduced, and typical time scales for the frequency of such events are determined. The effect of microlensing on broad emission lines of quasars is explored. In contrast to common wisdom it is found that microlensing can influence such emission lines: in the spectra of different images of a multiple quasar, a broad emission line should show different profiles due to the fact that the light has traversed different regions, and, thus, different star fields of the lensing galaxy. ESA

N92-22304*# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
THE OPTICAL DEPTH OF THE 158 MICROMETER (C-12 II) LINE: DETECTION OF THE F=1 YIELDS 0 (C-13 III) HYPERFINE-STRUCTURE COMPONENT
G. J. Stacey, C. H. Townes, A. Poglitsch, S. C. Madden, J. M. Jackson, F. Herrmann, R. Genzel, and N. Geis (California Univ., Berkeley.) Oct. 1991 16 p Submitted for publication
(Grant NAG2-208)
(NASA-CR-190255; NAS 1.26:190255; MPE-Preprint-211; ETN-92-91201) Copyright Avail: NTIS HC/MF A03 CSCL 03A

The first detection of the F = 1 yields 0 hyperfine component of the 158 micrometer (C-13 II) fine structure line in the interstellar medium is reported. A twelve point intensity map was obtained of the (C-13 II) distribution over the inner 190 inch (right ascension) by 190 inch (declination) regions of the Orion nebula using an imaging Fabry-Perot interferometer. The (C-12 II)/(C-13 II) line intensity ratio varied significantly over the region mapped. It is highest (86 plus or minus 9) in the core of the Orion H II region and significantly lower (62 plus or minus 7) in the outer regions of the map, reflecting higher optical depth in the (C-12 II) line here. It is suggested that this enhanced optical depth is the result of limb brightening of the optically thin (C-13 II) line at the edges of the bowl-shaped H II region blister. If the C-12/C-13 abundance ratio is 43, the (C-12 II) line in the inner regions of the Orion nebula, has a low optical depth: tau sub 12 approximately = 0.75 plus or minus 0.25. The optical depth together with the large brightness temperature of the (C-12 II) line (approximately 160 K) requires that the excitation temperature of the P-2 sub 3/2 level be approximately 310 K, in very good agreement with the previous analysis of the physical conditions of the Orion interface region based on fine structure line intensity ratios and photodissociation region models. If the C-12/C-13 abundance ratio is 67, the line optical depth is somewhat larger (tau sub 12 approximately = 1.85), and the transition excitation temperature is somewhat smaller (approximately 190 K) than that predicted by these models. The present results therefore support values approximately = 43 for the C-12/C-13 abundance ratio in the Orion nebula. ESA

N92-22387*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NASA MARSHALL SPACE FLIGHT CENTER SOLAR OBSERVATORY REPORT, JULY - DECEMBER 1991
James E. Smith Mar. 1992 116 p
(NASA-TM-103577; NAS 1.15:103577) Avail: NTIS HC/MF A06 CSCL 03A

A summary is given of the solar vector magnetic field, H-alpha, and white light observations made at the NASA/Marshall Space Flight Center (MSFC) Solar Observatory during its daily periods of observation. The MSFC Solar Observatory facilities consist of the Solar Magnetograph, an f-13, 30 cm Cassegrain system with a 3.5 cm image of the Sun housed on top of a 12.8 meter tower, a 12.5 cm Razdow H-alpha telescope housed at the base of the

tower, an 18 cm Questar telescope with a full aperture white-light filter mounted at the base of the tower, a 30 cm Cassegrain telescope located in a second metal dome, and a 16.5 cm H-alpha telescope mounted on the side of the Solar Vector Magnetograph. A concrete block building provides office space, a darkroom for developing film and performing optical testing, a workshop, video displays, and a computer facility for data reduction. Author

N92-22626# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SPACE PROJECTS: STATUS AND REMAINING CHALLENGES OF THE ADVANCED X RAY ASTROPHYSICS FACILITY. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON VA, HUD, AND INDEPENDENT AGENCIES, COMMITTEE ON APPROPRIATIONS, US SENATE
Feb. 1992 29 p
(GAO/NSIAD-92-77; B-247419) Avail: NTIS HC/MF A03; also available from GAO, P.O. Box 6015, Gaithersburg, MD 20877 HC first five copies free, additional copies $2.00

The Advanced X-ray Astrophysics Facility is being designed for NASA at an estimated cost of $2.0 billion. It is to be one of the mainstays of the nation's space science program for the next decade. A review of the program's status is presented. The specific objectives were to assess: (1) program cost and schedule status and risk; (2) results of mirror tests to date; and (3) remaining technical challenges. Author

N92-22963*# Smithsonian Astrophysical Observatory, Cambridge, MA.
THEORETICAL STUDIES OF THE OUTER ENVELOPES OF YOUNG STELLAR OBJECTS Semiannual Progress Report No. 16, 1 Oct. 1983 - 31 Dec. 1991
Lee Hartmann 15 Apr. 1992 21 p
(Grant NAGw-511)
(NASA-CR-190208; NAS 1.26:190208) Avail: NTIS HC/MF A03 CSCL 03A

With the Monte Carlo code developed by Whitney and Hartmann, a series of models was computed of scattering in disks around young stellar objects. The code calculates scattering by dust, including polarization, in arbitrary geometries. By computing model images, it was found that disk, by themselves, around young stellar objects would be very difficult to detect with present day imaging techniques. In comparing these images to observations of young stellar objects which show diffuse structure, little resemblance was found. A flared disk system will only give high polarization when viewed edge-on, and the position angle is always oriented perpendicular to the disk plane. This suggests that an envelope, perhaps the remnant infalling envelope, must be present to scatter more stellar light than a disk can, and obscure the star at many inclinations. A grid was computed of models of scattering in a disk+envelope system. Evidence is presented that the wind of the pre-main sequence object FU Orionis arises from the surface of the luminous prostellar accretion disk. A disk wind model calculated assuming radiative equilibrium explains the differential behavior of the observed asymmetrical absorption line profiles. The model predicts that strong lines should be asymmetric and blueshifted, while weak lines should be symmetric and doubled peaked due to disk rotation, in agreement with observations. Author

N92-22612*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ASTROTECH 21 PROGRAM OVERVIEW Abstract Only
J. Cutts and J. Fordyce *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 1 Aug. 1991 2 p (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03A

N92-22615*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
REPORT OF THE X RAY AND GAMMA RAY SENSORS PANEL
Andrew Szymkowiak, S. Collins, J. Kurfess, W. Mahoney, D. McCammon, R. Pehl, and G. Ricker (Massachusetts Inst. of Tech., Cambridge.) *In* JPL, California Inst. of Tech., Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 18-26 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03A

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics.*

N92-22168 California Inst. of Tech., Pasadena.
PARALLEL HIERARCHICAL N-BODY METHODS Ph.D. Thesis
John K. Salmon 1991 334 p
Avail: Univ. Microfilms Order No. DA9137285

Recent algorithmic advances utilizing hierarchical data structures have resulted in a dramatic reduction in the time required for computer simulation of N-body systems with long-range interactions. Computations which required O(N exp 2) operations can now be done in O(N log N) or O(N). We review these tree methods and find that they may be distinguished based on a few simple features. The Barnes-Hut (BH) algorithm has received a great deal of attention, and is the subject of the remainder of the dissertation. We present a generalization of the BH tree and analyze the statistical properties of such trees in detail. We also consider the expected number of operations entailed by an execution of the BH algorithm. We find an optimal value for m, the maximum number of bodies in a terminal cell, and confirm that the number of operations is O(N log N), even if the distribution of bodies is not uniform. The mathematical basis of all hierarchical methods is the multipole approximation. We discuss multipole approximations, for the case of arbitrary, spherically symmetric, and Newtonian Green's functions. We describe methods for computing multipoles and evaluating multipole approximations in each of these cases, emphasizing the tradeoff between generality and algorithmic complexity. N-body simulations in computational astrophysics can require 10(exp 6) or even more bodies. Algorithmic advances are not sufficient, in and of themselves, to make computations of this size feasible. Parallel computation offers, a priori, the necessary computational power in terms of speed and memory. We show how the BH algorithm can be adapted to execute in parallel. We use orthogonal recursive bisection to partition space. The logical communication structure that emerges is that of a hypercube. A local version of the BH tree is constructed in each processor by iteratively exchanging data along each edge of the logical hypercube. We obtain speedups in excess of 380 on a 512 processor system for simulations of galaxy mergers with 180000 bodies. We analyze the performance of the parallel version of the algorithm and find that the overhead is due primarily to interprocessor synchronization delays and redundant computation. Communication is not a significant factor. Author

N92-22187 Texas Univ., Austin.
TURBULENCE AND NONLINEAR BEHAVIOR IN THE INTERSTELLAR MEDIUM Ph.D. Thesis
Enrique Cristian Vazquez 1991 203 p
Avail: Univ. Microfilms Order No. DA9200742

The interstellar medium (ISM), as revealed by recent high resolution observations, is spatially very complex, with structure at all scales and the ability to nonlinearly exchange energy between them. It is thus, in the most general sense, turbulent. Yet, most existing ISM models overlook this fact mainly because of the lack of analytical solutions and the impossibly large amounts of computer power required in numerical simulations. Here, the turbulence and nonlinearity of the ISM dynamics are approached in two ways. First, a cloud-fluid model that describes the variations in the number, velocity dispersion, and mean mass of an ensemble of interstellar clouds due to collisions, star formation, and external agents is presented. Next, a method is presented for reducing the number of active degrees of freedom in turbulent solutions of hydrodynamic equations in Fourier space, while preserving the

exact form and quadratic conservation properties of the full problem. For compressible 2D flows, the results are compatible with semi-analytic weakly-compressible calculations and existing numerical simulations. Preliminary low-resolution results at higher compressibility indicate that the nonlinear transfer does not exhibit any increased non-localness compared to the incompressible case, although the reverse nature of the energy transfer is lost. Also, a form of intermittency is found, albeit of a somewhat different nature than that of incompressible 3D flows. Author

N92-22244 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
ATOMIC AND MOLECULAR OUTFLOW IN DR21
A. P. G. Russel, J. Bally, R. Padman, and R. E. Hills (Mullard Radio Astronomy Observatory, Cambridge, England) Sep. 1991 37 p Submitted for publication
(MPE-Preprint-210; ETN-92-91200) Copyright Avail: MPI fuer Physik und Astrophysik, 8046 Garching bei Muenchen, Fed. Republic of Germany

Observations of the 21 cm H(0) line and of the J 3-2 transitions of HCO(+) in DR21 are presented. The H(0) observations reveal a massive (24 solar mass) jet which is red shifted by up to 90 km/s, with peak H(0) column density 2 times 10 to the 21st power/sq cm. This jet is three orders of magnitude more massive than the H(0) wind seen in HH7-11 and is capable of driving the molecular outflow in DR21 in a momentum conserving interaction. The molecular line observations show that the outflow in DR21 contains about 170 solar mass of dense material. They also reveal a second cloud core to the west of DR21 which appears to be associated with H(0) emission from shock dissociation of H2. A model is presented in which the H(0) jet is formed by recombination of an initially ionized outflow from DR21. ESA

N92-22256 California Univ., Santa Cruz.
FORMATION AND EVOLUTION OF GALAXIES AND LARGE-SCALE STRUCTURE IN THE UNIVERSE Ph.D. Thesis
Scot Stewart Olivier 1991 226 p
Avail: Univ. Microfilms Order No. DA9202155

Two separate topics in the field of astrophysical cosmology are studied. First, the effect of systematic errors, especially projection contamination, on the calculation of the two point cluster autocorrelation function is examined for several samples of rich clusters of galaxies. In the complete redshift samples of Abell clusters, projection decontamination and other systematic errors generally reduce the amplitude or the 3-D autocorrelations by about a factor of two, and xi sub cc(r) is not different from 0 at the 1(sigma) level for r greater than or approx. 40h(exp -1) Mpc. These results are consistent with the predictions of the 'standard' Cold Dark Matter model. Second, models for the evolution of the disk of spiral galaxies that include the effects of viscosity but assume no continuous infall of gas onto the disk are studied. The time scale for star formation is assumed to be of the same order as the time scale for viscous redistribution of the mass and angular momentum in the disk. The effect of varying parameters describing the form of the viscosity and the form of the star formation law and the distribution of the initial gas disk is studied.
Dissert. Abstr.

N92-22257 Cornell Univ., Ithaca, NY.
ASTROPHYSICS IN STRONG MAGNETIC FIELDS: ACCRETION DECELERATION AND SYNCHROTRON RADIATION IN MAGNETIC NEUTRON STARS Ph.D. Thesis
Robert Warren Nelson 1991 128 p
Avail: Univ. Microfilms Order No. DA9204038

Radiation from X ray pulsars originates from the accretion of matter from a gaseous binary companion into the highly magnetized atmosphere of a neutron star. For luminosities where radiation pressure can be ignored, accreting ions deposit their kinetic energy into the atmosphere predominantly by magnetic Coulomb scattering with atmospheric electrons as well as by exciting collective plasma oscillations. The deceleration and energy loss was calculated of accreting gas in a plane parallel, homogeneous, magnetized plasma. The motion of atmospheric electrons perpendicular to the magnetic field is quantized in Landau orbitals with energies perpendicular to the magnetic field (perpendicular Energy = n(E sub B) = 11.6 (n(B/(10 exp 12)G) kev). It was found that magnetic stopping profiles are similar to the field free case, and stopping lengths are similar to the B = 0 values with the approx. substitution in LAMBDA sub c yields ln 2n sub eff, where LAMBDA sub c is the classical Coulomb logarithm. In addition, for typical atmospheric densities and field strengths B greater or approx. 5(10 exp 10) G excited electrons return to the ground state primarily by radiative deexcitation, producing cyclotron photons. Dissert. Abstr.

N92-22259 Princeton Univ., NJ.
GRAVITATIONAL LENSING BY CLUSTERS OF GALAXIES Ph.D. Thesis
Jordi Miralda-Escude 1991 233 p
Avail: Univ. Microfilms Order No. DA9202537

Gravitational lensing is examined of background galaxies by clusters of galaxies and large scale structure. First, the effects were studied of lensing in the weak regime, where ellipticities of the lensed sources are changed by a small amount. The effect of a cluster of galaxies is considered, and the accuracy is calculated with which several parameters of the gravitational potential of a cluster can be measured from the distorted images of the background galaxies. This accuracy is limited by the random, intrinsic ellipticities of the sources, and their limited number. Current observations do not yet achieve this accuracy because of other systematic errors, mainly low resolution and confusion of cluster galaxies with background galaxies. The effect was also considered of lensing by all density fluctuations in the line of sight to a randomly chosen field of galaxies; it is shown how the detection of coherent alignments in the ellipticities of background galaxies can be used to measure the amplitude of these density fluctuations, and the shape of their power spectrum. The case of strong distortions is also analyzed, where a source is highly magnified, and becomes easily seen as an arc. Dissert. Abstr.

N92-22260 Liverpool Univ. (England).
TOPICS IN STRING THEORY AND COSMOLOGY Ph.D. Thesis
Adrian Michael Lawrence 1989 120 p
Avail: Univ. Microfilms Order No. BRDX94039

Sigma model and string theory effective actions are discussed. The construction is outlined of the general form of such actions with particular reference to field redefinitions and to the algebraic properties of the Riemann and torsion tensors. Field redefinitions were used to prove that there are no unitarity violating ghosts (perturbatively in the string tension) and this fact was used to study the stability of Friedmann-Robertson-Walker spacetimes. It was found that stability depends on the geometry of the compact space involved and on the absence of ghosts. Motivated by this, it was discovered that the act of removing a ghost at one order introduces one at a higher order so that it can not be necessarily assumed that the effective action is ghost free nonperturbatively.
Dissert. Abstr.

N92-22261 Princeton Univ., NJ.
COSMIC STRUCTURE FROM GLOBAL TEXTURE Ph.D. Thesis
Andrew Kenneth Gooding 1991 135 p
Avail: Univ. Microfilms Order No. DA9202530

A study was made of cosmic structure formation in an Omega = 1 cold dark matter (CDM) cosmogony in which the CDM density fluctuations are induced by global texture. An initially smooth CDM density field is perturbed by the ordering dynamics of scalar fields following a symmetry breaking phase transition in the early universe. The ordering dynamics include the collapse and unwinding of unstable topological defects called knots. An analytic model maps the growth of fluctuations induced by individual texture knots, and combines the effect of many such knots to describe the evolution of a population of gravitationally bound CDM objects. The model also yields a power spectrum and related statistics describing the resulting large scale structure, matching well with the predictions of numerical simulations. An early generation of collapsed objects may have reionized the universe, smoothing the cosmic background radiation on scales less than a few degrees. Most objects approx.

10(exp 12) solar mass form by z approx. 3, consistent with the observed epoch of quasar formation, and observations of galaxies at high redshifts, which are so problematic to other models.
Dissert. Abstr.

N92-22653# International Centre for Theoretical Physics, Trieste (Italy).
ELECTROSTATIC DRIFT VORTICES IN A HOT ROTATING STRONGLY MAGNETIZED ELECTRON-POSITRON PULSAR PLASMA
U. A. Mofiz Jul. 1991 8 p
(DE92-614464; IC-91/177) Avail: NTIS HC/MF A02

Electrostatic drift wave in a hot rotating and strongly magnetized electron-positron pulsar plasma is considered. Using relativistic two fluid equations a pair of coupled nonlinear equations is derived. It is shown that the wave can propagate in the form of two-dimensional dipolar vortices at ultrarelativistic temperature (T much greater than mc(sup 2)) of the plasma. The latter may affect the energy transport in the hot plasma, which can lead to a new turbulent state in the pulsar magnetosphere. DOE

N92-22613*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE NEXT CENTURY ASTROPHYSICS PROGRAM
Paul N. Swanson *In its* Workshop Proceedings: Sensor Systems for Space Astrophysics in the 21st Century, Volume 2 1 Aug. 1991 p 7-14 (For primary document see N92-22610 13-88)
Avail: NTIS HC/MF A05; 1 functional color page CSCL 03B

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-22177 Washington Univ., Seattle.
A DIMENSIONAL HIERARCHY OF NUMERICAL SIMULATIONS OF MARTIAN GLOBAL DUST STORMS Ph.D. Thesis
James Richard Murphy 1991 317 p
Avail: Univ. Microfilms Order No. DA9131686

An investigation of various processes of possible importance during martian global (planetary-scale) dust storms is conducted via a series of one-, two-, and three-dimensional numerical simulations utilizing a coupled system of aerosol transport/microphysical and atmospheric dynamic models. Three-dimensional interactive dust storm simulation indicates that zonally asymmetric components of the circulation are required for transport of substantial quantities of dust to north polar regions from a southern subtropical surface dust source. Transport by greatly excited atmospheric dynamic components is very efficient at mixing dust over the globe in a short time. Various dynamic components (thermal tides, baroclinic waves, etc.) are affected by the developing simulated storms. The time and zonal mean overturning circulation increases in magnitude and extent at storm initiation, but does not extend beyond the northern hemisphere middle latitudes. No polar warming like that observed during the 1977B storm is produced in either three-dimensional simulation. Comparison of model results with Viking observation, as well as implications for polar warming and positive-negative feedbacks between dust loading and lifting are discussed. Dissert. Abstr.

N92-22262 Cornell Univ., Ithaca, NY.
SATURN'S RINGS: PHOTOMETRIC STUDIES OF THE C RING AND RADIAL VARIATION IN THE KEELER GAP Ph.D. Thesis
Maren Leyla Cooke 1991 341 p
Avail: Univ. Microfilms Order No. DA9203982

, Voyager 1 and 2 images of Saturn's rings are analyzed in independent studies of two different aspects of the rings. First, the light scattering behavior or the C Ring particles is examined using a classical radiative transfer analysis of radically resolved image data from both spacecraft. Double scattering and saturnshine are included as corrections to the observed I/F, and then the single scattering solution to the radiative transfer equation is inverted to produce the albedo-phase function product at each radius. The authors iterate to produce an average single particle phase function, which displays finite forward scattering that may be due either to surface roughness or to an unmodeled dust population. Secondly, a study was made of the Keeler Gap, whose inner edge exhibits a strong (amplitude approx. 4 to 6 km) radial variation. Gap widths are measured from aximuthally averaged radial scans of I/F, and fit to sine curves. A basically bimodal distribution was found in the fitted wavelength of the oscillation among different image sets, centered on approx. 7 and 12 degs. The effects were considered of embedded satellites and of resonances with external satellites as possible contributors to the observed structure. Dissert. Abstr.

N92-22961*# Lunar and Planetary Inst., Houston, TX.
TOWARDS OTHER PLANETARY SYSTEMS (TOPS): A TECHNOLOGY NEEDS IDENTIFICATION WORKSHOP
David C. Black and Kenji Nishioka 1991 26 p Workshop held in Houston, TX, 22-24 Apr. 1991
(Grant NAG2-657)
(NASA-CR-190177; NAS 1.26:190177; LPI/TR-92-01) Avail: NTIS HC/MF A03 CSCL 03B

The workshop identified a strong commonality between the technology needs for NASA's TOPS program and the technology needs that were identified for NASA's astrophysics program through its Astrotech 21 survey. The workshop encourages NASA to have the Solar System Exploration and Astrophysics Div. work cooperatively to share in technology studies that are common to both programs, rather than to conduct independent studies. It was also clear, however, that there are technology needs specific to TOPS, and these should be pursued by the Solar System Exploration Div. There are two technology areas that appear to be particularly critical to realizing the ultimate performance that is being sought under the TOPS program, these areas are metrology and optics. The former is critical in calibration and verification of instrument performance, while the latter is needed to provide optical systems of sufficient quality to conduct a search for and characterization of other planetary systems at the more extreme levels of performance identified in TOPS program. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

N92-23094*# Delaware Univ., Newark. Bartol Research Inst.
PARTICLE ACCELERATION, TRANSPORT AND TURBULENCE IN COSMIC AND HELIOSPHERIC PHYSICS Annual Progress Report
W. Matthaeus [1992] 19 p
(Grant NAGw-1573)
(NASA-CR-190232; NAS 1.26:190232) Avail: NTIS HC/MF A03 CSCL 03B

In this progress report, the long term goals, recent scientific progress, and organizational activities are described. The scientific focus of this annual report is in three areas: first, the physics of particle acceleration and transport, including heliospheric modulation and transport, shock acceleration and galactic propagation and reacceleration of cosmic rays; second, the development of theories of the interaction of turbulence and large scale plasma and magnetic field structures, as in winds and shocks; third, the elucidation of the nature of magnetohydrodynamic turbulence processes and the role such turbulence processes might play in heliospheric, galactic, cosmic ray physics, and other space physics applications. H.A.

N92-23113*# Colorado Univ., Boulder.
AN INVESTIGATION OF THE SOLAR CYCLE RESPONSE OF ODD-NITROGEN IN THE THERMOSPHERE Progress Report

David W. Rusch and Stanley C. Solomon Mar. 1992 9 p
(Grant NAG5-1525)
(NASA-CR-190237; NAS 1.26:190237) Avail: NTIS HC/MF A02 CSCL 03B

This annual report covers the first year of funding for the study of the solar cycle variations of odd-nitrogen (N((sup 2)D), N((sup 4)S), NO) in the Earth's thermosphere. The study uses the extensive data base generated by the Atmosphere Explorer (AE) satellites, and the Solar Mesosphere Explorer Satellite. The AE data are being used, for the first time, to define the solar variability effect on the odd-nitrogen species through analysis of the emissions at 520 nano-m from N((sup 2)D) and the emission from O(+)((sup 2)P). Additional AE neutral and ion density data are used to help define and quantify the physical processes controlling the variations. The results from the airglow study will be used in the next two years of this study to explain the solar cycle changes in NO measured by the Solar Mesosphere Explorer. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N92-22169 Pennsylvania State Univ., University Park.
RADIATION DYNAMICS IN X RAY BINARIES Ph.D. Thesis
Mark Andrew Walker 1991 231 p
Avail: Univ. Microfilms Order No. DA9127445

Radiation can play a significant role in the transport of angular momentum from relativistic accretion disks, leading to intrinsically nonlinear systems. Here, we consider what this implies for the non-pulsing X-ray binary systems, particularly with regard to the X-ray bursters. Our considerations are founded on a time-dependent model of a geometrically thin, axisymmetric accretion disk around a nonmagnetic neutron star. Weakly magnetic systems are also considered, but prove less interesting. The model is fully relativistic, and cast within a Kerr geometry. We develop the equations describing the evolution of such a disk, incorporating photon torques, and then solve numerically for various cases. Spectra are estimated using Monte Carlo methods. Of obvious interest is the case where a thermonuclear shell flash occurs on the central star. This prompts an accretion transient, and we find that accretion may contribute the majority of the burst energy. Enhanced accretion depletes the inner disk, and this scouring effect may sometimes be visible as a depressed post-burst luminosity. We also consider irradiation by the star-disk boundary-layer in both optically thin, and optically thick limits. In the latter case we find that the accretion rate undergoes relaxation osciliations if the stellar radius is close to that of the marginally stable orbit. This behavior mimics that of the Rapid Burster (XBT1730-335), and we investigate the model as an explanation for this unique source. Predicted temporal and spectral properties are both in reasonable agreement with the data. If the stellar radius is less than that of the marginally stable orbit, then we enter a new regime of both temporal and spectral behavior where the stresses due to the radiation field are larger than any other stress-energy contribution associated with the accretion flow. Copious hard X-ray power is then required by the large radial infall speeds interior to the marginally stable orbit. Further, the complete nonlinearity and positive feedback of the radiation field suggest a highly variable luminosity. We therefore identify these systems with the so-called 'black hole candidate.'
Dissert. Abstr.

N92-22218*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EFFICIENT HZETRN (A GALACTIC COSMIC RAY TRANSPORT CODE)
Judy L. Shinn and John W. Wilson Apr. 1992 17 p
(NASA-TP-3147; L-16954; NAS 1.60:3147) Avail: NTIS HC/MF A03 CSCL 03B

An accurate and efficient engineering code for analyzing the shielding requirements against the high-energy galactic heavy ions is needed. The HZETRN is a deterministic code developed at Langley Research Center that is constantly under improvement both in physics and numerical computation and is targeted for such use. One problem area connected with the space-marching technique used in this code is the propagation of the local truncation error. By improving the numerical algorithms for interpolation, integration, and grid distribution formula, the efficiency of the code is increased by a factor of eight as the number of energy grid points is reduced. The numerical accuracy of better than 2 percent for a shield thickness of 150 g/cm(exp 2) is found when a 45 point energy grid is used. The propagating step size, which is related to the perturbation theory, is also reevaluated. Author

N92-22499*# Boeing Co., Seattle, WA. Defense and Space Group.
SOLAR EXPOSURE OF LDEF EXPERIMENT TRAYS
R. J. Bourassa and J. R. Gillis Feb. 1992 265 p
(Contract NAS1-18224)
(NASA-CR-189554; NAS 1.26:189554) Avail: NTIS HC/MF A12 CSCL 03B

Exposure to solar radiation is one of the primary causes of degradation of materials on spacecraft. Accurate knowledge of solar exposure is needed to evaluate the performance of materials carried on the Long Duration Exposure Facility (LDEF) during its nearly 6 year orbital flight. Presented here are tables and figures of calculated solar exposure for the experiment rows, longerons, and end bays of the spacecraft as functions of time in orbit. The data covers both direct solar and earth reflected radiation. Results are expressed in cumulative equivalent sun hours (CESH) or the hours of direct, zero incidence solar radiation that would cause the same irradiance of a surface. Space end bays received the most solar radiation, 14,000 CESH; earth end bays received the least, 4,500 CESH. Row locations received between 6,400 CESH and 11,200 CESH with rows facing either eastward or westward receiving the most radiation and rows facing northward or southward receiving the least. Author

N92-22628# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DISTRIBUTION OF RADIO SOURCES TOWARDS CLUSTERS OF GALAXIES M.S. Thesis [DISTRIBUICAO DE RADIOFONTES NA DIRECAO DE AGLOMERADOS DE GALAXIAS]
Carmen Maria Andreazza Feb. 1991 108 p In PORTUGUESE; ENGLISH summary
(INPE-5268-TDI/444) Avail: NTIS HC/MF A06

A statistical analysis of the radio sources toward clusters of galaxies is presented. The results show that the sources are highly concentrated towards the cluster centers. The density enhancement of sources within 0.05 Abell radii ranges from 3 to 25 above background, but rises to approx. 100 for high frequency, when only strong sources are considered. The richer (R greater than or equal to 2) clusters and early Bautz-Morgan types (BM less than II) show the highest concentration of sources above background. Often a source deficiency relative to the background is found in the cluster peripheries. The source count shows an excess of strong radio sources towards the cluster centers. In low frequencies, a deficiency of weak sources is found towards clusters of BM less than II morphological types. Author

99 GENERAL

N92-22423*# National Aeronautics and Space Administration, Washington, DC.
TECHNOLOGY 2001: THE SECOND NATIONAL TECHNOLOGY TRANSFER CONFERENCE AND EXPOSITION, VOLUME 1
Dec. 1991 527 p Conference held in San Jose, CA, 3-5 Dec. 1991

(NASA-CP-3136-Vol-1; NAS 1.55:3136-Vol-1) Avail: NTIS HC/MF A23 CSCL 05B

Papers from the technical sessions of the Technology 2001 Conference and Exposition are presented. The technical sessions featured discussions of advanced manufacturing, artificial intelligence, biotechnology, computer graphics and simulation, communications, data and information management, electronics, electro-optics, environmental technology, life sciences, materials science, medical advances, robotics, software engineering, and test and measurement. For individual titles, see N92-22424 through N92-22483.

N92-22424*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CERAMIC SUSCEPTOR FOR INDUCTION BONDING OF METALS, CERAMICS, AND PLASTICS **c27**

Robert L. Fox and John D. Buckley *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 3-9 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 11C

A thin (.005) flexible ceramic susceptor (carbon) was discovered. It was developed to join ceramics, plastics, metals, and combinations of these materials using a unique induction heating process. Bonding times for laboratory specimens comparing state of the art technology to induction bonding were cut by a factor of 10 to 100 times. This novel type of carbon susceptor allows for applying heat directly and only to the bondline without heating the entire structure, supports, and fixtures of a bonding assembly. The ceramic (carbon film) susceptor produces molten adhesive or matrix material at the bond interface. This molten material flows through the perforated susceptor producing a fusion between the two parts to be joined, which in many instances has proven to be stronger than the parent material. Bonding can be accomplished in 2 minutes on areas submitted to the inductive heating. Because a carbon susceptor is used in bonding carbon fiber reinforced plastics and ceramics, there is no radar signature or return making it an ideal process for joining advanced aerospace composite structures. Author

N92-22425*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

APPLYING NASA'S EXPLOSIVE SEAM WELDING **c31**

Laurence J. Bement *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 10-23 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 13H

The status of an explosive seam welding process, which was developed and evaluated for a wide range of metal joining opportunities, is summarized. The process employs very small quantities of explosive in a ribbon configuration to accelerate a long-length, narrow area of sheet stock into a high-velocity, angular impact against a second sheet. At impact, the oxide films of both surface are broken up and ejected by the closing angle to allow atoms to bond through the sharing of valence electrons. This cold-working process produces joints having parent metal properties, allowing a variety of joints to be fabricated that achieve full strength of the metals employed. Successful joining was accomplished in all aluminum alloys, a wide variety of iron and steel alloys, copper, brass, titanium, tantalum, zirconium, niobium, telerium, and columbium. Safety issues were addressed and are as manageable as many currently accepted joining processes. Author

N92-22426*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

WELDING TECHNOLOGY TRANSFER TASK/LASER BASED WELD JOINT TRACKING SYSTEM FOR COMPRESSOR GIRTH WELDS **c37**

Alan Looney *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 24-31 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 13H

Sensors to control and monitor welding operations are currently being developed at Marshall Space Flight Center. The laser based weld bead profiler/torch rotation sensor was modified to provide a weld joint tracking system for compressor girth welds. The tracking system features a precision laser based vision sensor, automated two-axis machine motion, and an industrial PC controller. The system benefits are elimination of weld repairs caused by joint tracking errors which reduces manufacturing costs and increases production output, simplification of tooling, and free costly manufacturing floor space. Author

N92-22427*# EG and G Rocky Flats, Inc., Golden, CO.

PRECISION JOINING CENTER **c37**

John W. Powell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 32-35 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 13H

The establishment of a Precision Joining Center (PJC) is proposed. The PJC will be a cooperatively operated center with participation from U.S. private industry, the Colorado School of Mines, and various government agencies, including the Department of Energy's Nuclear Weapons Complex (NWC). The PJC's primary mission will be as a training center for advanced joining technologies. This will accomplish the following objectives: (1) it will provide an effective mechanism to transfer joining technology from the NWC to private industry; (2) it will provide a center for testing new joining processes for the NWC and private industry; and (3) it will provide highly trained personnel to support advance joining processes for the NWC and private industry. Author

N92-22428*# National Cancer Inst., Bethesda, MD. Office of Technology Development.

COOPERATIVE RESEARCH AND DEVELOPMENT OPPORTUNITIES WITH THE NATIONAL CANCER INSTITUTE **c52**

Kathleen Sybert *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 39-46 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 06P

The Office of Technology Development (OTD) of the National Cancer Institute (NCI) is responsible for negotiating Cooperative Research and Development Agreements (CRADAs), whereby the knowledge resulting from NCI investigators' government-sponsored research is developed in collaboration with universities and/or industry into new products of importance for the diagnosis and treatment of cancer and acquired immunodeficiency syndrome (AIDS). The NCI has recently executed a unique 'clinical trials' CRADA and is developing a model agreement based upon it for the development and commercialization of products for the diagnosis and treatment of cancer and AIDS. NCI drug screening, preclinical testing, clinical trials, and AIDS program capabilities form the basis for this new technology development/technology transfer vehicle. NCI's extensive drug screening program and 'designer foods' program serve as potential sources of investigational new drugs (INDs) and cancer preventatives. Collaborations between NCI and pharmaceutical companies having the facilities, experience, and expertise necessary to develop INDs into approved drugs available to the public are being encouraged where the companies have proprietary rights to INDs, or where NCI has proprietary rights to INDs and invites companies to respond to a collaborator announcement published in the Federal Register. The joint efforts of the NCI and the chosen collaborator are designed to generate the data necessary to obtain pharmaceutic regulatory approval from the Food and Drug Administration (FDA) to market the drugs developed, and thereby make them available to health care providers for the diagnosis and treatment of cancer and AIDS. Author

N92-22429*# Centers for Disease Control, Atlanta, GA. Technology Transfer Office.

TECHNOLOGIES FOR THE MARKETPLACE FROM THE CENTERS FOR DISEASE CONTROL **c52**

Frances L. Reid-Sanden, R. Eric Greene, and Dolores M. Malvitz *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 47-50 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 06P

The Centers for Disease Control, a Public Health Service agency, is responsible for the prevention and control of disease and injury. Programs range from surveillance and prevention of chronic and infectious diseases to occupational health and injury control. These programs have produced technologies in a variety of fields, including vaccine development, new methods of disease diagnosis, and new tools to ensure a safer work environment. Author

N92-22430*# Northeastern Forest Experiment Station, Delaware, OH. Forestry Sciences Lab.

ENHANCEMENT OF BIOLOGICAL CONTROL AGENTS FOR USE AGAINST FOREST INSECT PESTS AND DISEASES THROUGH BIOTECHNOLOGY **c51**

James M. Slavicek *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 51-58 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 06C

Research and development efforts in our research group are focused on the generation of more efficacious biological control agents through the techniques of biotechnology for use against forest insect pests and diseases. Effective biological controls for the gypsy moth and for tree fungal wilt pathogens are under development. The successful use of Gypchek, a formulation of the Lymantria dispar nuclear polyhedrosis virus (LdNPV), in gypsy moth control programs has generated considerable interest in that agent. As a consequence of its specificity, LdPNV has negligible adverse ecological impacts compared to most gypsy moth control agents. However, LdNPV is not competitive with other control agents in terms of cost and efficacy. We are investigating several parameters of LdNPV replication and polyhedra production in order to enhance viral potency and efficacy thus mitigating the current disadvantages of LdNPV for gypsy moth control, and have identified LdNPV variants that will facilitate these efforts. Tree endophytic bacteria that synthesize antifungal compounds were identified and an antibiotic compound from one of these bacteria was characterized. The feasibility of developing tree endophytes as biological control agents for tree vascular fungal pathogens is being investigated. Author

N92-22431*# Brookhaven National Lab., Upton, NY. Biology Dept.

USE OF T7 RNA POLYMERASE TO DIRECT EXPRESSION OF OUTER SURFACE PROTEIN A (OspA) FROM THE LYME DISEASE SPIROCHETE, BORRELIA BURGDORFERI **c51**

John J. Dunn and Barbara N. Lade *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 59-64 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 06C

The OspA gene from a North American strain of the Lyme disease Spirochete, Borrelia burgdorferi, was cloned under the control of transciption and translation signals from bacteriophage T7. Full-length OspA protein, a 273 amino acid (31kD) lipoprotein, is expressed poorly in Escherichia coli and is associated with the insoluble membrane fraction. In contrast, a truncated form of OspA lacking the amino-terminal signal sequence which normally would direct localization of the protein to the outer membrane is expressed at very high levels (less than or equal to 100 mg/liter) and is soluble. The truncated protein was purified to homogeneity and is being tested to see if it will be useful as an immunogen in a vaccine against Lyme disease. Circular dichroism and fluorescence spectroscopy was used to characterize the secondary structure and study conformational changes in the protein. Studies underway with other surface proteins from B burgdorferi and a related spirochete, B. hermsii, which causes relapsing fever, leads us to conclude that a strategy similar to that used to express the truncated OspA can provide a facile method for producing variations of Borrelia lipoproteins which are highly expressed in E. coli and soluble without exposure to detergents. Author

N92-22432*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

COMMERCIAL APPLICATIONS OF THE ACTS MOBILE TERMINAL MILLIMETER-WAVE ANTENNAS **c32**

Arthur C. Densmore, Rick A. Crist, Vahraz Jamnejad, and Ann N. Tulintseff *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 67-71 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 17B

NASA's Jet Propulsion Laboratory is currently developing the Advanced Communications Technology Satellite (ACTS) Mobile Terminal (AMT), which will provide voice, data, and video communications to and from a vehicle (van, truck, or car) via NASA's geostationary ACTS satellite using the K- and K(sub a)-band frequency bands. The AMT is already planned to demonstrate a variety of communications from within the mobile vehicular environment, and within this paper a summary of foreseen commercial application opportunities is given. A critical component of the AMT is its antenna system, which must establish and maintain the basic RF link with the satellite. Two versions of the antenna are under development, each incorporating different technologies and offering different commercial applications. Author

N92-22433*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ANTENNAS FOR MOBILE SATELLITE COMMUNICATIONS **c32**

John Huang *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 72-81 (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 17B

A NASA sponsored program, called the Mobile Satellite (MSAT) system, has prompted the development of several innovative antennas at L-band frequencies. In the space segment of the MSAT system, an efficient, light weight, circularly polarized microstrip array that uses linearly polarized elements was developed as a multiple beam reflector feed system. In the ground segment, a low-cost, low-profile, and very efficient microstrip Yagi array was developed as a medium-gain mechanically steered vehicle antenna. Circularly shaped microstrip patches excited at higher-order modes were also developed as low-gain vehicle antennas. A more recent effort called for the development of a 20/30 GHz mobile terminal antenna for future-generation mobile satellite communications. To combat the high insertion loss encountered at 20/30 GHz, series-fed Monolithic Microwave Integrated Circuit (MMIC) microstrip array antennas are currently being developed. These MMIC arrays may lead to the development of several small but high-gain Ka-band antennas for the Personal Access Satellite Service planned for the 2000s. Author

N92-22434*# Pacific Monolithics, Inc., Sunnyvale, CA.

MMIC LINEAR-PHASE AND DIGITAL MODULATORS FOR DEEP SPACE SPACECRAFT X-BAND TRANSPONDER APPLICATIONS **c32**

Narayan R. Mysoor and Fazal Ali *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 82-88 Prepared for Jet Propulsion Lab., California Inst. of Tech., Pasadena (For primary document see N92-22423 13-99)

Avail: NTIS HC/MF A23 CSCL 17B

The design concepts, analyses, and development of GaAs monolithic microwave integrated circuit (MMIC) linear-phase and digital modulators for the next generation of space-borne

communications systems are summarized. The design approach uses a compact lumped element quadrature hybrid and Metal Semiconductor Field Effect Transistors (MESFET)-varactors to provide low loss and well-controlled phase performance for deep space transponder (DST) applications. The measured results of the MESFET-diode show a capacitance range of 2:1 under reverse bias, and a Q of 38 at 10 GHz. Three cascaded sections of hybrid-coupled reflection phase shifters were modeled and simulations performed to provide an X-band (8415 +/- 50 MHz) DST phase modulator with +/- 2.5 radians of peak phase deviation. The modulator will accommodate downlink signal modulation with composite telemetry and ranging data, with a deviation linearity tolerance of +/- 8 percent and insertion loss of less than 8 +/- 0.5 dB. The MMIC digital modulator is designed to provide greater than 10 Mb/s of bi-phase modulation at X-band. Author

N92-22435*# Hughes Aircraft Co., El Segundo, CA. Space and Communications Group.
PHASED ARRAY ANTENNA BEAMFORMING USING OPTICAL PROCESSOR **c32**
L. P. Anderson, F. Boldissar, and D. C. D. Chang *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 89-98 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17B

The feasibility of optical processor based beamforming for microwave array antennas is investigated. The primary focus is on systems utilizing the 20/30 GHz communications band and a transmit configuration exclusively to serve this band. A mathematical model is developed for computation of candidate design configurations. The model is capable of determination of the necessary design parameters required for spatial aspects of the microwave 'footprint' (beam) formation. Computed example beams transmitted from geosynchronous orbit are presented to demonstrate network capabilities. The effect of the processor on the output microwave signal to noise quality at the antenna interface is also considered. Author

N92-22436*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
GLOBAL POSITIONING SYSTEM SUPPORTED PILOT'S DISPLAY **c04**
Marshall M. Scott, Jr., Temel Erdogan, Andrew P. Schwalb, and Charles H. Curley (Boeing Aerospace Co., Kennedy Space Center, FL.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 101-108 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 17G

The hardware, software, and operation of the Microwave Scanning Beam Landing System (MSBLS) Flight Inspection System Pilot's Display is discussed. The Pilot's Display is used in conjunction with flight inspection tests that certify the Microwave Scanning Beam Landing System used at Space Shuttle landing facilities throughout the world. The Pilot's Display was developed for the pilot of test aircraft to set up and fly a given test flight path determined by the flight inspection test engineers. This display also aids the aircraft pilot when hazy or cloud cover conditions exist that limit the pilot's visibility of the Shuttle runway during the flight inspection. The aircraft position is calculated using the Global Positioning System and displayed in the cockpit on a graphical display. Author

N92-22437*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
APPLICATION OF TECHNOLOGY DEVELOPED FOR FLIGHT SIMULATION AT NASA. LANGLEY RESEARCH CENTER **c09**
Jeff I. Cleveland, II *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 109-117 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 14B

In order to meet the stringent time-critical requirements for real-time man-in-the-loop flight simulation, computer processing operations including mathematical model computation and data input/output to the simulators must be deterministic and be completed in as short a time as possible. Personnel at NASA's Langley Research Center are currently developing the use of supercomputers for simulation mathematical model computation for real-time simulation. This, coupled with the use of an open systems software architecture, will advance the state-of-the-art in real-time flight simulation. Author

N92-22438*# Sterling Federal Systems, Inc., Palo Alto, CA.
FAST: A MULTI-PROCESSED ENVIRONMENT FOR VISUALIZATION OF COMPUTATIONAL FLUID DYNAMICS **c34**
Gordon V. Bancroft, Fergus J. Merritt, Todd C. Plessel, Paul G. Kelaita, and R. Kevin McCabe *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 118-127 (For primary document see N92-22423 13-99)
(Contract NAS2-13210)
Avail: NTIS HC/MF A23 CSCL 20D

Three-dimensional, unsteady, multi-zoned fluid dynamics simulations over full scale aircraft are typical of the problems being investigated at NASA Ames' Numerical Aerodynamic Simulation (NAS) facility on CRAY2 and CRAY-YMP supercomputers. With multiple processor workstations available in the 10-30 Mflop range, we feel that these new developments in scientific computing warrant a new approach to the design and implementation of analysis tools. These larger, more complex problems create a need for new visualization techniques not possible with the existing software or systems available as of this writing. The visualization techniques will change as the supercomputing environment, and hence the scientific methods employed, evolves even further. The Flow Analysis Software Toolkit (FAST), an implementation of a software system for fluid mechanics analysis, is discussed.
Author

N92-22439*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A NEAR-REAL-TIME FULL-PARALLAX HOLOGRAPHIC DISPLAY FOR REMOTE OPERATIONS **c35**
Helene P. Iavecchia, Lloyd Huff (Dayton Univ. Research Inst., OH.), and Neville I. Marzwell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 128-136 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

A near real-time, full parallax holographic display system was developed that has the potential to provide a 3-D display for remote handling operations in hazardous environments. The major components of the system consist of a stack of three spatial light modulators which serves as the object source of the hologram; a near real-time holographic recording material (such as thermoplastic and photopolymer); and an optical system for relaying SLM images to the holographic recording material and to the observer for viewing. Author

N92-22440*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Center for Space Microelectronics Technology.
NON-VOLATILE, HIGH DENSITY, HIGH SPEED, MICROMAGNET-HALL EFFECT RANDOM ACCESS MEMORY (MHRAM) **c60**
Jiin C. Wu, Romney R. Katti, and Henry L. Stadler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 139-146 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

The micromagnetic Hall effect random access memory (MHRAM) has the potential of replacing ROMs, EPROMs, EEPROMs, and SRAMs because of its ability to achieve non-volatility, radiation hardness, high density, and fast access times, simultaneously. Information is stored magnetically in small magnetic elements (micromagnets), allowing unlimited data

retention time, unlimited numbers of rewrite cycles, and inherent radiation hardness and SEU immunity, making the MHRAM suitable for ground based as well as spaceflight applications. The MHRAM device design is not affected by areal property fluctuations in the micromagnet, so high operating margins and high yield can be achieved in large scale integrated circuit (IC) fabrication. The MHRAM has short access times (less than 100 nsec). Write access time is short because on-chip transistors are used to gate current quickly, and magnetization reversal in the micromagnet can occur in a matter of a few nanoseconds. Read access time is short because the high electron mobility sensor (InAs or InSb) produces a large signal voltage in response to the fringing magnetic field from the micromagnet. High storage density is achieved since a unit cell consists only of two transistors and one micromagnet Hall effect element. By comparison, a DRAM unit cell has one transistor and one capacitor, and a SRAM unit cell has six transistors. Author

N92-22441*# Naval Research Lab., Washington, DC.
ANALOG VLSI NEURAL NETWORK INTEGRATED CIRCUITS **c33**

F. J. Kub, K. K. Moon, and E. A. Just *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 147-155 Sponsored in part by ONR and Office of Naval Technology (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

Two analog very large scale integration (VLSI) vector matrix multiplier integrated circuit chips were designed, fabricated, and partially tested. They can perform both vector-matrix and matrix-matrix multiplication operations at high speeds. The 32 by 32 vector-matrix multiplier chip and the 128 by 64 vector-matrix multiplier chip were designed to perform 300 million and 3 billion multiplications per second, respectively. An additional circuit that has been developed is a continuous-time adaptive learning circuit. The performance achieved thus far for this circuit is an adaptivity of 28 dB at 300 KHz and 11 dB at 15 MHz. This circuit has demonstrated greater than two orders of magnitude higher frequency of operation than any previous adaptive learning circuit. Author

N92-22442*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MONOLITHIC MICROWAVE INTEGRATED CIRCUIT WATER VAPOR RADIOMETER **c33**

L. M. Sukamto, T. W. Cooley, M. A. Janssen, and G. S. Parks *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 156-160 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

A proof of concept Monolithic Microwave Integrated Circuit (MMIC) Water Vapor Radiometer (WVR) is under development at the Jet Propulsion Laboratory (JPL). WVR's are used to remotely sense water vapor and cloud liquid water in the atmosphere and are valuable for meteorological applications as well as for determination of signal path delays due to water vapor in the atmosphere. The high cost and large size of existing WVR instruments motivate the development of miniature MMIC WVR's, which have great potential for low cost mass production. The miniaturization of WVR components allows large scale deployment of WVR's for Earth environment and meteorological applications. Small WVR's can also result in improved thermal stability, resulting in improved calibration stability. Described here is the design and fabrication of a 31.4 GHz MMIC radiometer as one channel of a thermally stable WVR as a means of assessing MMIC technology feasibility. Author

N92-22443*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Center for Space Microelectronics Technology.
A NOVEL NONCONTACTING WAVEGUIDE BACKSHORT FOR MILLIMETER AND SUBMILLIMETER WAVE FREQUENCIES **c33**

W. R. McGrath *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 161-168 Sponsored in part by Strategic Defense Initiative Organization (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

A new noncontacting waveguide backshort was developed for millimeter and submillimeter wave frequencies. It employs a metallic bar with rectangular or circular holes. The size and spacing of the holes are adjusted to provide a periodic variation of the guide impedance on the correct length scale to give a large reflection of RF frequency power. This design is mechanically rugged and can be easily fabricated for millimeter wave frequencies above 300 GHz where conventional backshorts are difficult to fabricate. Model experiments were performed at 4 to 6 GHz to optimize the design. Values of reflected power greater than 95 percent over a 30 percent bandwidth were achieved. The design was scaled to WR-10 band (75 to 110 GHz) with comparably good results. Author

N92-22444*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NOVEL APPLICATIONS FOR TAZ-8A **c26**

Stephen M. Riddlebaugh and William J. Waters *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 171-182 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11F

Recent needs in the non-aerospace industrial sector have revitalized interest in high performance alloys. TAZ-8A has a combination of properties that makes it unique: a high temperature strength, oxidation resistance, abrasion resistance, and exceptional thermal shock resistance. The major drawback for the utilization of this alloy is the relatively high cost compared with the more common iron base alloys. Reduced material consumption and lower costs are possible by using coatings of TAZ-8A on a low cost substrate. Coatings were applied using plasma spray techniques developed by NASA as well as modified plasma vapor deposition (PVD) techniques. Author

N92-22445*# National Aeronautics and Space Administration. White Sands Test Facility, NM.
TEST METHODS FOR DETERMINING THE SUITABILITY OF METAL ALLOYS FOR USE IN OXYGEN-ENRICHED ENVIRONMENTS **c26**

Joel M. Stoltzfus and Mohan V. Gunaji (Lockheed Engineering and Sciences Co., Las Cruces, NM.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 183-192 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11F

Materials are more flammable in oxygen rich environments than in air. When the structural elements of a system containing oxygen ignite and burn, the results are often catastrophic, causing loss of equipment and perhaps even human lives. Therefore, selection of the proper metallic and non-metallic materials for use in oxygen systems is extremely important. While test methods for the selection of non-metallic materials have been available for years, test methods for the selection of alloys have not been available until recently. Presented here are several test methods that were developed recently at NASA's White Sands Test Facility (WSTF) to study the ignition and combustion of alloys, including the supersonic and subsonic speed particle impact tests, the frictional heating and coefficient of friction tests, and the promoted combustion test. These test methods are available for commercial use. Author

N92-22446*# Ultramet, Pacoima, CA.
A MAJOR ADVANCE IN POWDER METALLURGY **c26**

Brian E. Williams, Jacob J. Stiglich, Jr., Richard B. Kaplan, and Robert H. Tuffias *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 193-202 (For primary document see

N92-22423 13-99)
(Contract DAAL04-88-C-0030)
Avail: NTIS HC/MF A23 CSCL 11F

Ultramet has developed a process which promises to significantly increase the mechanical properties of powder metallurgy (PM) parts. Current PM technology uses mixed powders of various constituents prior to compaction. The homogeneity and flaw distribution in PM parts depends on the uniformity of mixing and the maintenance of uniformity during compaction. Conventional PM fabrication processes typically result in non-uniform distribution of the matrix, flaw generation due to particle-particle contact when one of the constituents is a brittle material, and grain growth caused by high temperature, long duration compaction processes. Additionally, a significant amount of matrix material is usually necessary to fill voids and create 100 percent dense parts. In Ultramet's process, each individual particle is coated with the matrix material, and compaction is performed by solid state processing. In this program, Ultramet coated 12-micron tungsten particles with approximately 5 wt percent nickel/iron. After compaction, flexure strengths were measured 50 percent higher than those achieved in conventional liquid phase sintered parts (10 wt percent Ni/Fe). Further results and other material combinations are discussed.
Author

N92-22447*# Army Electronics Technology and Devices Lab., Fort Monmouth, NJ.
PERMANENT MAGNET DESIGN METHODOLOGY c70
Herbert A. Leupold *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 203-214 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20C

Design techniques developed for the exploitation of high energy magnetically rigid materials such as Sm-Co and Nd-Fe-B have resulted in a revolution in kind rather than in degree in the design of a variety of electron guidance structures for ballistic and aerospace applications. Salient examples are listed. Several prototype models were developed. These structures are discussed in some detail: permanent magnet solenoids, transverse field sources, periodic structures, and very high field structures.
Author

N92-22448*# Midwest Research Inst., Golden, CO.
MANUFACTURING WITH THE SUN c44
Lawrence M. Murphy, Steven G. Hauser, and Richard J. Clyne *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 217-224 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 10A

Concentrated solar radiation is now a viable alternative source for many advanced manufacturing processes. Researchers at the National Renewable Energy Laboratory (NREL) have demonstrated the feasibility of processes such as solar induced surface transformation of materials (SISTM), solar based manufacturing, and solar pumped lasers. Researchers are also using sunlight to decontaminate water and soils polluted with organic compounds; these techniques could provide manufacturers with innovative alternatives to traditional methods of waste management. The solar technology that is now being integrated into today's manufacturing processes offer greater potential for tomorrow, especially as applied to the radiation abundant environment available in space and on the lunar surface.
Author

N92-22449*# Oak Ridge National Lab., TN.
ULTRA-PRECISION PROCESSES FOR OPTICS MANUFACTURING c74
William R. Martin *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 225-234 Sponsored in part by Strategic Defense Initiative Organization (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

The Optics MODIL (Manufacturing Operations Development and Integration Laboratory) is developing advanced manufacturing technologies for fabrication of ultra precision optical components, aiming for a ten-fold improvement in precision and a shortening of the scheduled lead time. Current work focuses on diamond single point turning, ductile grinding, ion milling, and in/on process metrology.
Author

N92-22450*# Naval Ocean Systems Center, San Diego, CA.
INTEGRATED AUTOMATION FOR MANUFACTURING OF ELECTRONIC ASSEMBLIES c33
T. Joseph Sampite *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 235-242 Previously announced as N92-20689 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

Since 1985, the Naval Ocean Systems Center has been identifying and developing needed technology for flexible manufacturing of hybrid microelectronic assemblies. Specific projects have been accomplished through contracts with manufacturing companies, equipment suppliers, and joint efforts with other government agencies. The resulting technology has been shared through semi-annual meetings with government, industry, and academic representatives who form an ad hoc advisory panel. More than 70 major technical capabilities have been identified for which new development is needed. Several of these developments have been completed and are being shared with industry.
Author

N92-22451*# Wright Lab., Wright-Patterson AFB, OH.
THE AIR FORCE MANUFACTURING TECHNOLOGY (MANTECH): TECHNOLOGY TRANSFER METHODOLOGY AS EXEMPLIFIED BY THE RADAR TRANSMIT/RECEIVE MODULE PROGRAM c33
Tracy Houpt and Margaret Ridgely *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 243-246 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

The Air Force Manufacturing Technology program is involved with the improvement of radar transmit/receive modules for use in active phased array radars for advanced fighter aircraft. Improvements in all areas of manufacture and test of these modules resulting in order of magnitude improvements in the cost of and the rate of production are addressed, as well as the ongoing transfer of this technology to the Navy.
Author

N92-22452*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GALLIUM ARSENIDE QUANTUM WELL-BASED FAR INFRARED ARRAY RADIOMETRIC IMAGER c35
Kathrine A. Forrest and Murzy D. Jhabvala *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 249-253 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 14B

We have built an array-based camera (FIRARI) for thermal imaging (lambda = 8 to 12 microns). FIRARI uses a square format 128 by 128 element array of aluminum gallium arsenide quantum well detectors that are indium bump bonded to a high capacity silicon multiplexer. The quantum well detectors offer good responsivity along with high response and noise uniformity, resulting in excellent thermal images without compensation for variation in pixel response. A noise equivalent temperature difference of 0.02 K at a scene temperature of 290 K was achieved with the array operating at 60 K. FIRARI demonstrated that AlGaAS quantum well detector technology can provide large format arrays with performance superior to mercury cadmium telluride at far less cost.
Author

N92-22453*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A VIDEO EVENT TRIGGER FOR HIGH FRAME RATE, HIGH RESOLUTION VIDEO TECHNOLOGY **c33**
Glenn L. Williams *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 254-260 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09C

When video replaces film the digitized video data accumulates very rapidly, leading to a difficult and costly data storage problem. One solution exists for cases when the video images represent continuously repetitive 'static scenes' containing negligible activity, occasionally interrupted by short events of interest. Minutes or hours of redundant video frames can be ignored, and not stored, until activity begins. A new, highly parallel digital state machine generates a digital trigger signal at the onset of a video event. High capacity random access memory storage coupled with newly available fuzzy logic devices permits the monitoring of a video image stream for long term or short term changes caused by spatial translation, dilation, appearance, disappearance, or color change in a video object. Pretrigger and post-trigger storage techniques are then adaptable for archiving the digital stream from only the significant video images. Author

N92-22454*# TeleRobotics International, Inc., Knoxville, TN.
AN ELECTRONIC PAN/TILT/ZOOM CAMERA SYSTEM **c35**
Steve Zimmermann and H. Lee Martin *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 261-270 (For primary document see N92-22423 13-99)
(Contract NAS1-18855)
Avail: NTIS HC/MF A23 CSCL 14E

A camera system for omnidirectional image viewing applications that provides pan, tilt, zoom, and rotational orientation within a hemispherical field of view (FOV) using no moving parts was developed. The imaging device is based on the effect that from a fisheye lens, which produces a circular image of an entire hemispherical FOV, can be mathematically corrected using high speed electronic circuitry. An incoming fisheye image from any image acquisition source is captured in memory of the device, a transformation is performed for the viewing region of interest and viewing direction, and a corrected image is output as a video image signal for viewing, recording, or analysis. As a result, this device can accomplish the functions of pan, tilt, rotation, and zoom throughout a hemispherical FOV without the need for any mechanical mechanisms. A programmable transformation processor provides flexible control over viewing situations. Multiple images, each with different image magnifications and pan tilt rotation parameters, can be obtained from a single camera. The image transformation device can provide corrected images at frame rates compatible with RS-170 standard video equipment. Author

N92-22455*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
FIBER OPTIC TV DIRECT **c74**
John E. Kassak *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 271-280 Prepared in cooperation with Boeing Co., Cocoa Beach, FL and Lockheed Missiles and Space Co., Kennedy Space Center, FL (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

The objective of the operational television (OTV) technology was to develop a multiple camera system (up to 256 cameras) for NASA Kennedy installations where camera video, synchronization, control, and status data are transmitted bidirectionally via a single fiber cable at distances in excess of five miles. It is shown that the benefits (such as improved video performance, immunity from electromagnetic interference and radio frequency interference, elimination of repeater stations, and more system configuration flexibility) can be realized if application of the proven fiber optic transmission concept is used. The control system will marry the lens, pan and tilt, and camera control functions into a modular based Local Area Network (LAN) control network. Such a system does not exist commercially at present since the Television Broadcast Industry's current practice is to divorce the positional controls from the camera control system. The application software developed for this system will have direct applicability to similar systems in industry using LAN based control systems. Author

N92-22456*# Brookhaven National Lab., Upton, NY.
WASTE MANAGEMENT TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROGRAMS AT BROOKHAVEN NATIONAL LABORATORY **c45**
Paul D. Kalb and Peter Colombo *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 283-291 (For primary document see N92-22423 13-99)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC/MF A23 CSCL 13B

Two thermoplastic processes for improved treatment of radioactive, hazardous, and mixed wastes were developed from bench scale through technology demonstration: polyethylene encapsulation and modified sulfur cement encapsulation. The steps required to bring technologies from the research and development stage through full scale implementation are described. Both systems result in durable waste forms that meet current Nuclear Regulatory Commission and Environmental Protection Agency regulatory criteria and provide significant improvements over conventional solidification systems such as hydraulic cement. For example, the polyethylene process can encapsulate up to 70 wt pct. nitrate salt, compared with a maximum of about 20 wt pct. for the best hydraulic cement formulation. Modified sulfur cement waste forms containing as much as 43 wt pct. incinerator fly ash were formulated, whereas the maximum quantity of this waste in hydraulic cement is 16 wt pct. Author

N92-22457*# Oak Ridge National Lab., TN. Environmental Sciences Div.
REGULATED BIOLUMINESCENCE AS A TOOL FOR BIOREMEDIATION PROCESS MONITORING AND CONTROL OF BACTERIAL CULTURES **c45**
Robert S. Burlage, Armin Heitzer, and Philip M. DiGrazia (Tennessee Univ., Knoxville.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 292-299 (For primary document see N92-22423 13-99)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC/MF A23 CSCL 13B

An effective on-line monitoring technique for toxic waste bioremediation using bioluminescent microorganisms has shown great potential for the description and optimization of biological processes. The lux genes of the bacterium Vibrio fischeri are used by this species to produce visible light. The lux genes can be genetically fused to the control region of a catabolic gene, with the result that bioluminescence is produced whenever the catabolic gene is induced. Thus the detection of light from a sample indicates that genetic expression from a specific gene is occurring. This technique was used to monitor biodegradation of specific contaminants from waste sites. For these studies, fusions between the lux genes and the operons for naphthalene and toluene/xylene degradation were constructed. Strains carrying one of these fusions respond sensitively and specifically to target substrates. Bioluminescence from these cultures can be rapidly measured in a nondestructive and noninvasive manner. The potential for this technique in this and other biological systems is discussed.
Author

N92-22458*# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
FIBER OPTIC-BASED BIOSENSOR **c74**
Frances S. Ligler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 300-307 Sponsored in part by Office

of Naval Technology and Marine Corps. (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20F

The NRL fiber optic biosensor is a device which measures the formation of a fluorescent complex at the surface of an optical fiber. Antibodies and DNA binding proteins provide the mechanism for recognizing an analyze and immobilizing a fluorescent complex on the fiber surface. The fiber optic biosensor is fast, sensitive, and permits analysis of hazardous materials remote from the instrumentation. The fiber optic biosensor is described in terms of the device configuration, chemistry for protein immobilization, and assay development. A lab version is being used for assay development and performance characterization while a portable device is under development. Antibodies coated on the fiber are stable for up to two years of storage prior to use. The fiber optic biosensor was used to measure concentration of toxins in the parts per billion (ng/ml) range in under a minute. Immunoassays for small molecules and whole bacteria are under development. Assays using DNA probes as the detection element can also be used with the fiber optic sensor, which is currently being developed to detect biological warfare agents, explosives, pathogens, and toxic materials which pollute the environment. Author

N92-22459*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AMBIENT-TEMPERATURE CO-OXIDATION CATALYSTS c25
Billy T. Upchurch, David R. Schryer, Kenneth G. Brown, and Erik J. Kielin (Old Dominion Univ., Norfolk, VA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 308-316 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 07D

Oxidation catalysts which operate at ambient temperature were developed for the recombination of carbon monoxide (CO) and oxygen (O2) dissociation products which are formed during carbon dioxide (CO2) laser operation. Recombination of these products to regenerate CO2 allows continuous operation of CO2 lasers in a closed cycle mode. Development of these catalyst materials provides enabling technology for the operation of such lasers from space platforms or in ground based facilities without constant gas consumption required for continuous open cycle operation. Such catalysts also have other applications in various areas outside the laser community for removal of CO from other closed environments such as indoor air and as an ambient temperature catalytic converter for control of auto emissions. Author

N92-22460*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HIGH TEMPERATURE ADHESIVES c27
Terry L. St.Clair *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 319-326 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11A

The aerospace and electronics industries have an ever increasing need for higher performance materials. In recent years, linear aromatic polyimides have been proven to be a superior class of materials for various applications in these industries. The use of this class of polymers as adhesives is continuing to increase. Several NASA Langley developed polyimides show considerable promise as adhesives because of their high glass transition temperatures, thermal stability, resistance to solvents/water, and their potential for cost effective manufacture. Author

N92-22461*# Naval Research Lab., Washington, DC.
FLUORINATED EPOXY RESINS WITH HIGH GLASS TRANSITION TEMPERATURES c27
James R. Griffith *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 327-329 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

Easily processed liquid resins of low dielectric constants and high glass transition temperatures are useful for the manufacture of certain composite electronic boards. That combination of properties is difficult to acquire when dielectric constants are below 2.5, glass transition temperatures are above 200 C and processability is of conventional practicality. A recently issued patent (US 4,981,941 of 1 Jan. 1991) teaches practical materials and is the culmination of 23 years of research and effort and 15 patents owned by the Navy in the field of fluorinated resins of several classes. In addition to high fluorine content, practical utility was emphasized. Author

N92-22462*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POLYIMIDES CONTAINING PENDENT SILOXANE GROUPS c27
John W. Connell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 330-338 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

The incorporation of siloxane units into the backbone of aromatic polyimides has been shown to impart certain advantages over the unmodified polyimides. These include enhanced solubility, lower moisture adsorption, lower dielectric constant, improved toughness and surface modification. Also, when exposed to an atomic oxygen environment these materials form an in-situ silicate (SiO2) surface coating which protects the underlying material from further erosion. These unique advantages make polyimide-siloxanes useful in a variety of electronic and aerospace applications. As part of an effort on high performance polymeric materials for potential aerospace applications, polyimides containing pendent siloxane groups are under study. These materials were prepared by reacting a functionalized siloxane compound with polyimides containing benzhydrol groups. Thin films of the polymers exhibited glass transition temperatures ranging from 167 to 235 C. Tensile strengths and moduli measured at 23 C ranged from 11 to 14 ksi and 250 to 450 ksi, respectively. The dielectric constant was lowered substantially from that of the unmodified polyimide. Author

N92-22463*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
CORROSION-PROTECTIVE COATINGS FROM ELECTRICALLY CONDUCTING POLYMERS c27
Karen Gebert Thompson, Coleman J. Bryan, Brian C. Benicewicz, and Debra A. Wrobleski (Los Alamos National Lab., NM.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 339-347 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

In a joint effort between NASA Kennedy and LANL, electrically conductive polymer coatings were developed as corrosion protective coatings for metal surfaces. At NASA Kennedy, the launch environment consist of marine, severe solar, and intermittent high acid and/or elevated temperature conditions. Electrically conductive polymer coatings were developed which impart corrosion resistance to mild steel when exposed to saline and acidic environments. Such coatings also seem to promote corrosion resistance in areas of mild steel where scratches exist in the protective coating. Such coatings appear promising for many commercial applications. Author

N92-22464*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMPUTATION OF INCOMPRESSIBLE VISCOUS FLOWS THROUGH ARTIFICIAL HEART DEVICES WITH MOVING BOUNDARIES c52
Cetin Kiris, Stuart Rogers, Dochan Kwak, and I.-Dee Chang (Stanford Univ., CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 351-358 (For primary

document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06A

The extension of computational fluid dynamics techniques to artificial heart flow simulations is illustrated. Unsteady incompressible Navier-Stokes equations written in 3-D generalized curvilinear coordinates are solved iteratively at each physical time step until the incompressibility condition is satisfied. The solution method is based on the pseudo compressibility approach and uses an implicit upwind differencing scheme together with the Gauss-Seidel line relaxation method. The efficiency and robustness of the time accurate formulation of the algorithm are tested by computing the flow through model geometries. A channel flow with a moving indentation is computed and validated with experimental measurements and other numerical solutions. In order to handle the geometric complexity and the moving boundary problems, a zonal method and an overlapping grid embedding scheme are used, respectively. Steady state solutions for the flow through a tilting disk heart valve was compared against experimental measurements. Good agreement was obtained. The flow computation during the valve opening and closing is carried out to illustrate the moving boundary capability. Author

N92-22465*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COMPUTER INTERFACES FOR THE VISUALLY IMPAIRED c54
Gerry Higgins *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 359-367 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05H

Information access via computer terminals extends to blind and low vision persons employed in many technical and nontechnical disciplines. Two aspects are detailed of providing computer technology for persons with a vision related handicap. First, research into the most effective means of integrating existing adaptive technologies into information systems was made. This was conducted to integrate off the shelf products with adaptive equipment for cohesive integrated information processing systems. Details are included that describe the type of functionality required in software to facilitate its incorporation into a speech and/or braille system. The second aspect is research into providing audible and tactile interfaces to graphics based interfaces. Parameters are included for the design and development of the Mercator Project. The project will develop a prototype system for audible access to graphics based interfaces. The system is being built within the public domain architecture of X windows to show that it is possible to provide access to text based applications within a graphical environment. This information will be valuable to suppliers to ADP equipment since new legislation requires manufacturers to provide electronic access to the visually impaired. Author

N92-22466*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXTENDED ATTENTION SPAN TRAINING SYSTEM c53
Alan T. Pope and Edward H. Bogart (Lockheed Engineering and Sciences Co., Hampton, VA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 368-374 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05I

Attention Deficit Disorder (ADD) is a behavioral disorder characterized by the inability to sustain attention long enough to perform activities such as schoolwork or organized play. Treatments for this disorder include medication and brainwave biofeedback training. Brainwave biofeedback training systems feed back information to the trainee showing him how well he is producing the brainwave pattern that indicates attention. The Extended Attention Span Training (EAST) system takes the concept a step further by making a video game more difficult as the player's brainwaves indicate that attention is waning. The trainee can succeed at the game only by maintaining an adequate level of attention. The EAST system is a modification of a biocybernetic system that is currently being used to assess the extent to which automated flight management systems maintain pilot engagement. This biocybernetic system is a product of a program aimed at developing methods to evaluate automated flight deck designs for compatibility with human capabilities. The EAST technology can make a contribution in the fields of medical neuropsychology and neurology, where the emphasis is on cautious, conservative treatment of youngsters with attention disorders. Author

N92-22467*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MAN/MACHINE INTERACTION DYNAMICS AND PERFORMANCE (MMIDAP) CAPABILITY c54
Harold P. Frisch *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 375-382 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05H

The creation of an ability to study interaction dynamics between a machine and its human operator can be approached from a myriad of directions. The Man/Machine Interaction Dynamics and Performance (MMIDAP) project seeks to create an ability to study the consequences of machine design alternatives relative to the performance of both machine and operator. The class of machines to which this study is directed includes those that require the intelligent physical exertions of a human operator. While Goddard's Flight Telerobotic's program was expected to be a major user, basic engineering design and biomedical applications reach far beyond telerobotics. Ongoing efforts are outlined of the GSFC and its University and small business collaborators to integrate both human performance and musculoskeletal data bases with analysis capabilities necessary to enable the study of dynamic actions, reactions, and performance of coupled machine/operator systems. Author

N92-22468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
HYBRID AUTOMATED RELIABILITY PREDICTOR INTEGRATED WORK STATION (HiREL) c61
Salvatore J. Bavuso *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 385-394 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

The Hybrid Automated Reliability Predictor (HARP) integrated reliability (HiREL) workstation tool system marks another step toward the goal of producing a totally integrated computer aided design (CAD) workstation design capability. Since a reliability engineer must generally graphically represent a reliability model before he can solve it, the use of a graphical input description language increases productivity and decreases the incidence of error. The captured image displayed on a cathode ray tube (CRT) screen serves as a documented copy of the model and provides the data for automatic input to the HARP reliability model solver. The introduction of dependency gates to a fault tree notation allows the modeling of very large fault tolerant system models using a concise and visually recognizable and familiar graphical language. In addition to aiding in the validation of the reliability model, the concise graphical representation presents company management, regulatory agencies, and company customers a means of expressing a complex model that is readily understandable. The graphical postprocessor computer program HARPO (HARP Output) makes it possible for reliability engineers to quickly analyze huge amounts of reliability/availability data to observe trends due to exploratory design changes. Author

N92-22469*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
Ada AND THE RAPID DEVELOPMENT LIFECYCLE c61
Lloyd DeForrest and Lynn Gref *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 395-405 (For primary

document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

JPL is under contract, through NASA, with the US Army to develop a state-of-the-art Command Center System for the US European Command (USEUCOM). The Command Center System will receive, process, and integrate force status information from various sources and provide this integrated information to staff officers and decision makers in a format designed to enhance user comprehension and utility. The system is based on distributed workstation class microcomputers, VAX- and SUN-based data servers, and interfaces to existing military mainframe systems and communication networks. JPL is developing the Command Center System utilizing an incremental delivery methodology called the Rapid Development Methodology with adherence to government and industry standards including the UNIX operating system, X Windows, OSF/Motif, and the Ada programming language. Through a combination of software engineering techniques specific to the Ada programming language and the Rapid Development Approach, JPL was able to deliver capability to the military user incrementally, with comparable quality and improved economies of projects developed under more traditional software intensive system implementation methodologies. Author

N92-22470*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

ADVANCES IN KNOWLEDGE-BASED SOFTWARE ENGINEERING c61

Walt Truszkowski *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 406-414 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

The underlying hypothesis of this work is that a rigorous and comprehensive software reuse methodology can bring about a more effective and efficient utilization of constrained resources in the development of large-scale software systems by both government and industry. It is also believed that correct use of this type of software engineering methodology can significantly contribute to the higher levels of reliability that will be required of future operational systems. An overview and discussion of current research in the development and application of two systems that support a rigorous reuse paradigm are presented: the Knowledge-Based Software Engineering Environment (KBSEE) and the Knowledge Acquisition fo the Preservation of Tradeoffs and Underlying Rationales (KAPTUR) systems. Emphasis is on a presentation of operational scenarios which highlight the major functional capabilities of the two systems. Author

N92-22471*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

REDUCING THE COMPLEXITY OF THE SOFTWARE DESIGN PROCESS WITH OBJECT-ORIENTED DESIGN c61

M. P. Schuler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 415-425 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

Designing software is a complex process. How object-oriented design (OOD), coupled with formalized documentation and tailored object diagraming techniques, can reduce the complexity of the software design process is described and illustrated. The described OOD methodology uses a hierarchical decomposition approach in which parent objects are decomposed into layers of lower level child objects. A method of tracking the assignment of requirements to design components is also included. Increases in the reusability, portability, and maintainability of the resulting products are also discussed. This method was built on a combination of existing technology, teaching experience, consulting experience, and feedback from design method users. The discussed concepts are applicable to hierarchal OOD processes in general. Emphasis is placed on improving the design process by documenting the details of the procedures involved and incorporating improvements into those procedures as they are developed. Author

N92-22472*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

ADVANCED TECHNIQUES AND TECHNOLOGY FOR EFFICIENT DATA STORAGE, ACCESS, AND TRANSFER c82

Robert F. Rice (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) and Warner Miller *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 429-435 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05B

Advanced techniques for efficiently representing most forms of data are being implemented in practical hardware and software form through the joint efforts of three NASA centers. These techniques adapt to local statistical variations to continually provide near optimum code efficiency when representing data without error. Demonstrated in several earlier space applications, these techniques are the basis of initial NASA data compression standards specifications. Since the techniques clearly apply to most NASA science data, NASA invested in the development of both hardware and software implementations for general use. This investment includes high-speed single-chip very large scale integration (VLSI) coding and decoding modules as well as machine-transferrable software routines. The hardware chips were tested in the laboratory at data rates as high as 700 Mbits/s. A coding module's definition includes a predictive preprocessing stage and a powerful adaptive coding stage. The function of the preprocessor is to optimally process incoming data into a standard form data source that the second stage can handle.The built-in preprocessor of the VLSI coder chips is ideal for high-speed sampled data applications such as imaging and high-quality audio, but additionally, the second stage adaptive coder can be used separately with any source that can be externally preprocessed into the 'standard form'. This generic functionality assures that the applicability of these techniques and their recent high-speed implementations should be equally broad outside of NASA.

Author

N92-22473*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

A VECTOR-PRODUCT INFORMATION RETRIEVAL SYSTEM ADAPTED TO HETEROGENEOUS, DISTRIBUTED COMPUTING ENVIRONMENTS c61

Mark E. Rorvig *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 436-441 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

Vector-product information retrieval (IR) systems produce retrieval results superior to all other searching methods but presently have no commercial implementations beyond the personal computer environment. The NASA Electronic Library Systems (NELS) provides a ranked list of the most likely relevant objects in collections in response to a natural language query. Additionally, the system is constructed using standards and tools (Unix, X-Windows, Notif, and TCP/IP) that permit its operation in organizations that possess many different hosts, workstations, and platforms. There are no known commercial equivalents to this product at this time. The product has applications in all corporate management environments, particularly those that are information intensive, such as finance, manufacturing, biotechnology, and research and development. Author

N92-22474*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

AUTOCLASS: AN AUTOMATIC CLASSIFICATION SYSTEM c63

John Stutz, Peter Cheeseman, and Robin Hanson (Sterling Software, Moffett Field, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 442-450 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 09B

The task of inferring a set of classes and class descriptions

most likely to explain a given data set can be placed on a firm theoretical foundation using Bayesian statistics. Within this framework, and using various mathematical and algorithmic approximations, the AutoClass System searches for the most probable classifications, automatically choosing the number of classes and complexity of class descriptions. A simpler version of AutoClass has been applied to many large real data sets, has discovered new independently-verified phenomena, and has been released as a robust software package. Recent extensions allow attributes to be selectively correlated within particular classes, and allow classes to inherit, or share, model parameters through a class hierarchy. The mathematical foundations of AutoClass are summarized. Author

N92-22475*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SILVABASE: A FLEXIBLE DATA FILE MANAGEMENT SYSTEM c82
Steven J. Lambing and Sandra J. Reynolds (Boeing Computer Support Services, Inc., Huntsville, AL.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 451-460 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 05B

The need for a more flexible and efficient data file management system for mission planning in the Mission Operations Laboratory (EO) at MSFC has spawned the development of Silvabase. Silvabase is a new data file structure based on a B+ tree data structure. This data organization allows for efficient forward and backward sequential reads, random searches, and appends to existing data. It also provides random insertions and deletions with reasonable efficiency, utilization of storage space well but not at the expense of speed, and performance of these functions on a large volume of data. Mission planners required that some data be keyed and manipulated in ways not found in a commercial product. Mission planning software is currently being converted to use Silvabase in the Spacelab and Space Station Mission Planning Systems. Silvabase runs on a Digital Equipment Corporation's popular VAX/VMS computers in VAX Fortran. Silvabase has unique features involving time histories and intervals such as in operations research. Because of its flexibility and unique capabilities, Silvabase could be used in almost any government or commercial application that requires efficient reads, searches, and appends in medium to large amounts of almost any kind of data. Author

N92-22476*# Naval Weapons Center, China Lake, CA. Chemistry Div.
NONLINEAR OPTICAL POLYMERS FOR ELECTRO-OPTIC SIGNAL PROCESSING c27
Geoffrey A. Lindsay *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 463-470 Sponsored in part by ONR (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

Photonics is an emerging technology, slated for rapid growth in communications systems, sensors, imagers, and computers. Its growth is driven by the need for speed, reliability, and low cost. New nonlinear polymeric materials will be a key technology in the new wave of photonics devices. Electron-conjubated polymeric materials offer large electro-optic figures of merit, ease of processing into films and fibers, ruggedness, low cost, and a plethora of design options. Several new broad classes of second-order nonlinear optical polymers were developed at the Navy's Michelson Laboratory at China Lake, California. Polar alignment in thin film waveguides was achieved by electric-field poling and Langmuir-Blodgett processing. Our polymers have high softening temperatures and good aging properties. While most of the films can be photobleached with ultraviolet (UV) light, some have excellent stability in the 500-1600 nm range, and UV stability in the 290-310 nm range. The optical nonlinear response of these polymers is subpicosecond. Electro-optic switches, frequency doublers, light modulators, and optical data storage media are some of the device applications anticipated for these polymers. Author

N92-22477*# Naval Research Lab., Washington, DC. Chemistry Div.
OPTICAL DATA STORAGE AND METALLIZATION OF POLYMERS c27
C. M. Roland and M. F. Sonnenschein *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 471-475 Sponsored in part by ONR (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 11C

The utilization of polymers as media for optical data storage offers many potential benefits and consequently has been widely explored. New developments in thermal imaging are described, wherein high resolution lithography is accomplished without thermal smearing. The emphasis was on the use of poly(ethylene terephthalate) film, which simultaneously serves as both the substrate and the data storage medium. Both physical and chemical changes can be induced by the application of heat and, thereby, serve as a mechanism for high resolution optical data storage in polymers. The extension of the technique to obtain high resolution selective metallization of poly(ethylene terephthalate) is also described. Author

N92-22478*# Naval Surface Warfare Center, Silver Spring, MD.
LASER DISCRIMINATION BY STIMULATED EMISSION OF A PHOSPHOR c36
V. K. Mathur and K. Chakrabarti (Advanced Technology and Research, Inc., Laurel, MD.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 476-484 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20E

A method for discriminating sources of UV, near infrared, and far infrared laser radiation was discovered. This technology is based on the use of a single magnesium sulfide phosphor doubly doped with rare earth ions, which is thermally/optically stimulated to generate colors correlatable to the incident laser radiation. The phosphor, after initial charging by visible light, exhibits green stimulated luminescence when exposed to a near infrared source (Nd: YAG laser). On exposure to far infrared sources (CO2 laser) the phosphor emission changes to orange color. A UV laser produces both an orange red as well as green color. A device using this phosphor is useful for detecting the laser and for discriminating between the near infrared, far infrared, and UV lasers. The technology is also capable of infrared laser diode beam profiling since the radiation source leaves an imprint on the phosphor that can be photographed. Continued development of the technology offers potential for discrimination between even smaller bandwidths within the infrared spectrum, a possible aid to communication or wavemixing devices that need to rapidly identify and process optical signals. Author

N92-22479*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
Q-SWITCHED LASER PRELASE DETECTION CIRCUIT c36
George E. Lockard *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 485-493 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 20E

A compact electronic circuit was developed to detect prelasing in Q-swithed pulsed laser systems and once detected to shut down the laser before the next laser pulse occurs. The circuit is small, compact, and uses a minimum of components which makes it quite economical, thus readily lending itself to commercial applications. It can easily be incorporated into virtually any Q-switched laser system or reliability of a laser system by reducing a source of possible costly optical damage. The circuit operation and instrument requirements necessary to incorporate the circuit into a laser system are discussed. Author

N92-22480*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
APPLICATIONS OF CELSS TECHNOLOGY TO CONTROLLED ENVIRONMENT AGRICULTURE **c54**
Maynard E. Bates (Bionetics Corp., Moffett Field, CA.) and David L. Bubenheim *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 497-506 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06K

Controlled environment agriculture (CEA) is defined as the use of environmental manipulation for the commercial production of organisms, whether plants or animals. While many of the technologies necessary for aquaculture systems in North America is nevertheless doubling approximately every five years. Economic, cultural, and environmental pressures all favor CEA over field production for many non-commodity agricultural crops. Many countries around the world are already dependent on CEA for much of their fresh food. Controlled ecological life support systems (CELSS), under development at ARC, KSC, and JSC expand the concept of CEA to the extent that all human requirements for food, oxygen, and water will be provided regenerated by processing of waste streams to supply plant inputs. The CELSS will likely contain plants, humans, possibly other animals, microorganisms and physically and chemical processors. In effect, NASA will create engineered ecosystems. In the process of developing the technology for CELSS, NASA will develop information and technology which will be applied to improving the efficiency, reliability, and cost effectiveness for CEA, improving its resources recycling capabilities, and lessening its environmental impact to negligible levels. Author

N92-22481*# Biotronics Technologies, Inc., Wauwatosa, WI.
TWO NEW ADVANCED FORMS OF SPECTROMETRY FOR SPACE AND COMMERCIAL APPLICATIONS **c25**
Kenneth J. Schlager *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 507-514 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 07D

Reagentless ultraviolet absorption spectrometry (UVAS) and Liquid Atomic Emission Spectrometry (LAES) represent new forms of spectrometry with extensive potential in both space and commercial applications. Originally developed under KSC sponsorship for monitoring nutrient solutions for the Controlled Ecological Life Support System (CELSS), both UVAS and LAES have extensive analytical capabilities for both organic and inorganic chemical compounds. Both forms of instrumentation involve the use of remote fiber optic probes and real-time measurements for on-line process monitoring. Commercial applications exist primarily in environmental analysis and for process control in the chemical, pulp and paper, food processing, metal plating, and water/wastewater treatment industries. Author

N92-22482*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A COATED-WIRE ION-SELECTIVE ELECTRODE FOR IONIC CALCIUM MEASUREMENTS **c25**
John W. Hines, Sara Arnaud, Marc Madou, Jose Joseph, and Arvind Jina (Teknekron Sensor Development Corp., Menlo Park, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 515-522 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 07D

A coated-wire ion-selective electrode for measuring ionic calcium was developed, in collaboration with Teknektron Sensor Development Corporation (TSDC). This coated wire electrode sensor makes use of advanced, ion-responsive polyvinyl chloride (PVC) membrane technology, whereby the electroactive agent is incorporated into a polymeric film. The technology greatly simplifies conventional ion-selective electrode measurement technology, and is envisioned to be used for real-time measurement of physiological and environment ionic constituents, initially calcium. A primary target biomedical application is the real-time measurement of urinary and blood calcium changes during extended exposure to microgravity, during prolonged hospital or fracture immobilization, and for osteoporosis research. Potential advanced life support applications include monitoring of calcium and other ions, heavy metals, and related parameters in closed-loop water processing and management systems. This technology provides a much simplified ionic calcium measurement capability, suitable for both automated in-vitro, in-vivo, and in-situ measurement applications, which should be of great interest to the medical, scientific, chemical, and space life sciences communities. Author

N92-22483*# School of Aerospace Medicine, Brooks AFB, TX. Crew Technology Div.
A 99 PERCENT PURITY MOLECULAR SIEVE OXYGEN GENERATOR **c54**
G. W. Miller *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 1 Dec. 1991 p 523-535 (For primary document see N92-22423 13-99)
Avail: NTIS HC/MF A23 CSCL 06K

Molecular sieve oxygen generating systems (MSOGS) have become the accepted method for the production of breathable oxygen on military aircraft. These systems separate oxygen for aircraft engine bleed air by application of pressure swing adsorption (PSA) technology. Oxygen is concentrated by preferential adsorption in nitrogen in a zeolite molecular sieve. However, the inability of current zeolite molecular sieves to discriminate between oxygen and argon results in an oxygen purity limitations of 93-95 percent (both oxygen and argon concentrate). The goal was to develop a new PSA process capable of exceeding the present oxygen purity limitations. A novel molecular sieve oxygen concentrator was developed which is capable of generating oxygen concentrations of up to 99.7 percent directly from air. The process is comprised of four absorbent beds, two containing a zeolite molecular sieve and two containing a carbon molecular sieve. This new process may find use in aircraft and medical breathing systems, and industrial air separation systems. The commercial potential of the process is currently being evaluated. Author

N92-22623*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE 1991 MARSHALL SPACE FLIGHT CENTER RESEARCH AND TECHNOLOGY Annual Report
1991 284 p
(NASA-TM-103554; NAS 1.15:103554) Avail: NTIS HC/MF A13 CSCL 05D

A compilation of 194 articles addressing research and technology activities at the Marshall Space Flight Center (MSFC) is given. Activities are divided into three major areas: advanced studies addressing transportation systems, space systems, and space science activities conducted primarily in the Program Development Directorate; research tasks carried out in the Space Science Laboratory; and technology programs hosted by a wide array of organizations at the Center. The theme for this year's report is 'Building for the Future'. Author

N92-22676*# National Aeronautics and Space Administration, Washington, DC.
TECHNOLOGY 2001: THE SECOND NATIONAL TECHNOLOGY TRANSFER CONFERENCE AND EXPOSITION, VOLUME 2
Dec. 1991 518 p Conference held in San Jose, CA, 3-5 Dec. 1991
(NASA-CP-3136-Vol-2; NAS 1.55:3136-Vol-2) Avail: NTIS HC/MF A22 CSCL 05B

Proceedings of the workshop are presented. The mission of the conference was to transfer advanced technologies developed by the Federal government, its contractors, and other high-tech organizations to U.S. industries for their use in developing new or improved products and processes. Volume two presents papers on the following topics: materials science, robotics, test and

measurement, advanced manufacturing, artificial intelligence, biotechnology, electronics, and software engineering. For individual titles, see N92-22677 through N92-22735.

N92-22677*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ADVANCED COMPOSITE MATERIALS AND PROCESSES c24
Robert M. Baucom *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 3-11 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

Composites are generally defined as two or more individual materials, which, when combined into a single material system, results in improved physical and/or mechanical properties. The freedom of choice of the starting components for composites allows the generation of materials that can be specifically tailored to meet a variety of applications. Advanced composites are described as a combination of high strength fibers and high performance polymer matrix materials. These advanced materials are required to permit future aircraft and spacecraft to perform in extended environments. Advanced composite precursor materials, processes for conversion of these materials to structures, and selected applications for composites are reviewed. Author

N92-22678*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RTM: COST-EFFECTIVE PROCESSING OF COMPOSITE STRUCTURES c24
Greg Hasko (Lockheed Engineering and Sciences Co., Hampton, VA.) and H. Benson Dexter *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 12-21 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

Resin transfer molding (RTM) is a promising method for cost effective fabrication of high strength, low weight composite structures from textile preforms. In this process, dry fibers are placed in a mold, resin is introduced either by vacuum infusion or pressure, and the part is cured. RTM has been used in many industries, including automotive, recreation, and aerospace. Each of the industries has different requirements of material strength, weight, reliability, environmental resistance, cost, and production rate. These requirements drive the selection of fibers and resins, fiber volume fractions, fiber orientations, mold design, and processing equipment. Research is made into applying RTM to primary aircraft structures which require high strength and stiffness at low density. The material requirements are discussed of various industries, along with methods of orienting and distributing fibers, mold configurations, and processing parameters. Processing and material parameters such as resin viscosity, perform compaction and permeability, and tool design concepts are discussed. Experimental methods to measure preform compaction and permeability are presented. Author

N92-22679*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A LOW COST METHOD OF TESTING COMPRESSION-AFTER-IMPACT STRENGTH OF COMPOSITE LAMINATES c24
Alan T. Nettles *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 22-31 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

A method was devised to test the compression strength of composite laminate specimens that are much thinner and wider than other tests require. The specimen can be up to 7.62 cm (3 in) wide and as thin as 1.02 mm (.04 in). The best features of the Illinois Institute of Technology Research Institute (IITRI) fixture are combined with an antibuckling jig developed and used at the University of Dayton Research Institute to obtain a method of compression testing thin, wide test coupons on any 20 kip (or larger) loading frame. Up to 83 pct. less composite material is needed for the test coupons compared to the most commonly used compression-after-impact (CAI) tests, which calls for 48 ply thick (approx. 6.12 mm) test coupons. Another advantage of the new method is that composite coupons of the exact lay-up and thickness of production parts can be tested for CAI strength, thus yielding more meaningful results. This new method was used to compression test 8 and 16 ply laminates of T300/934 carbon/epoxy. These results were compared to those obtained using ASTM standard D 3410-87 (Celanese compression test). CAI testing was performed on IM6/3501-6, IM7/SP500 and IM7/F3900. The new test method and associated fixture work well and is a valuable asset to MSFC's damage tolerance program. Author

N92-22680*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
RESONANT ACOUSTIC DETERMINATION OF COMPLEX ELASTIC MODULI c71
David A. Brown and Steven L. Garrett *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 32-40 Sponsored in part by Naval Sea Systems Command (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20A

A simple, inexpensive, yet accurate method for measuring the dynamic complex modulus of elasticity is described. Using a 'free-free' bar selectively excited in three independent vibrational modes, the shear modulus is obtained by measuring the frequency of the torsional resonant mode and the Young's modulus is determined from measurement of either the longitudinal or flexural mode. The damping properties are obtained by measuring the quality factor (Q) for each mode. The Q is inversely proportional to the loss tangent. The viscoelastic behavior of the sample can be obtained by tracking a particular resonant mode (and thus a particular modulus) using a phase locked loop (PLL) and by changing the temperature of the sample. The change in the damping properties is obtained by measuring the in-phase amplitude of the PLL which is proportional to the Q of the material. The real and imaginary parts or the complex modulus can be obtained continuously as a function of parameters such as temperature, pressure, or humidity. For homogeneous and isotropic samples only two independent moduli are needed in order to characterize the complete set of elastic constants, thus, values can be obtained for the dynamic Poisson's ratio, bulk modulus, Lame constants, etc. Author

N92-22681*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE CLIMBING CRAWLING ROBOT (A UNIQUE CABLE ROBOT FOR SPACE AND EARTH) c37
James J. Kerley, Edward May, and Wayne Eklund *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 43-50 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13I

Some of the greatest concerns in robotic designs have been the high center of gravity of the robot, the irregular or flat surface that the robot has to work on, the weight of the robot that has to handle heavy weights or use heavy forces, and the ability of the robot to climb straight up in the air. This climbing crawling robot handles these problems well with magnets, suction cups, or actuators. The cables give body to the robot and it performs very similar to a caterpillar. The computer program is simple and inexpensive as is the robot. One of the important features of this system is that the robot can work in pairs or triplets to handle jobs that would be extremely difficult for single robots. The light weight of the robot allows it to handle quite heavy weights. The number of feet give the robot many roots where a simple set of feet would give it trouble. Author

N92-22682*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A LIGHTWEIGHT, HIGH STRENGTH DEXTEROUS MANIPULATOR FOR COMMERCIAL APPLICATIONS **c37**
Neville I. Marzwell, Bruce M. Schena, and Steve M. Cohan (Odetics, Inc., Anaheim, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 51-59 (For primary document see N92-22676 13-99)
(Contract NAS7-1062)
Avail: NTIS HC/MF A22 CSCL 13I

The concept, design, and features are described of a lightweight, high strength, modular robot manipulator being developed for space and commercial applications. The manipulator has seven fully active degrees of freedom and is fully operational in 1 G. Each of the seven joints incorporates a unique drivetrain design which provides zero backlash operation, is insensitive to wear, and is single fault tolerant to motor or servo amplifier failure. Feedback sensors provide position, velocity, torque, and motor winding temperature information at each joint. This sensing system is also designed to be single fault tolerant. The manipulator consists of five modules (not including gripper). These modules join via simple quick-disconnect couplings and self-mating connectors which allow rapid assembly and/or disassembly for reconfiguration, transport, or servicing. The manipulator is a completely enclosed assembly, with no exposed components or wires. Although the initial prototype will not be space qualified, the design is well suited to meeting space requirements. The control system provides dexterous motion by controlling the endpoint location and arm pose simultaneously. Potential applications are discussed. Author

N92-22683*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REAL-TIME, INTERACTIVE, VISUALLY UPDATED SIMULATOR SYSTEM FOR TELEPRESENCE **c37**
Frederick S. Schebor, Jerry L. Turney (KMS Industries, Ann Arbor, MI.), and Neville I. Marzwell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 60-70 (For primary document see N92-22676 13-99)
(Contract NAS7-1074)
Avail: NTIS HC/MF A22 CSCL 13I

Time delays and limited sensory feedback of remote telerobotic systems tend to disorient teleoperators and dramatically decrease the operator's performance. To remove the effects of time delays, key components were designed and developed of a prototype forward simulation subsystem, the Global-Local Environment Telerobotic Simulator (GLETS) that buffers the operator from the remote task. GLETS totally immerses an operator in a real-time, interactive, simulated, visually updated artificial environment of the remote telerobotic site. Using GLETS, the operator will, in effect, enter into a telerobotic virtual reality and can easily form a gestalt of the virtual 'local site' that matches the operator's normal interactions with the remote site. In addition to use in space based telerobotics, GLETS, due to its extendable architecture, can also be used in other teleoperational environments such as toxic material handling, construction, and undersea exploration. Author

N92-22684*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A HAZARD CONTROL SYSTEM FOR ROBOT MANIPULATORS **c37**
Ruth Chiang Carter and Adrian Rad (Hernandez Engineering, Inc., Greenbelt, MD.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 71-80 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13I

A robot for space applications will be required to complete a variety of tasks in an uncertain, harsh environment. This fact presents unusual and highly difficult challenges to ensuring the safety of astronauts and keeping the equipment they depend on from becoming damaged. The systematic approach being taken to control hazards that could result from introducing robotics technology in the space environment is described. First, system safety management and engineering principles, techniques, and requirements are discussed as they relate to Shuttle payload design and operation in general. The concepts of hazard, hazard category, and hazard control, as defined by the Shuttle payload safety requirements, is explained. Next, it is shown how these general safety management and engineering principles are being implemented on an actual project. An example is presented of a hazard control system for controlling one of the hazards identified for the Development Test Flight (DTF-1) of NASA's Flight Telerobotic Servicer, a teleoperated space robot. How these schemes can be applied to terrestrial robots is discussed as well. The same software monitoring and control approach will insure the safe operation of a slave manipulator under teleoperated or autonomous control in undersea, nuclear, or manufacturing applications where the manipulator is working in the vicinity of humans or critical hardware. Author

N92-22685*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
KNOWLEDGE-BASED AUTONOMOUS TEST ENGINEER (KATE) **c61**
Carrie L. Parrish and Barbara L. Brown *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 83-92 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

Mathematical models of system components have long been used to allow simulators to predict system behavior to various stimuli. Recent efforts to monitor, diagnose, and control real-time systems using component models have experienced similar success. NASA Kennedy is continuing the development of a tool for implementing real-time knowledge-based diagnostic and control systems called KATE (Knowledge based Autonomous Test Engineer). KATE is a model-based reasoning shell designed to provide autonomous control, monitoring, fault detection, and diagnostics for complex engineering systems by applying its reasoning techniques to an exchangeable quantitative model describing the structure and function of the various system components and their systemic behavior. Author

N92-22686*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ADVANCED COMPUTED TOMOGRAPHY INSPECTION SYSTEM (ACTIS): AN OVERVIEW OF THE TECHNOLOGY AND ITS APPLICATION **c38**
Lisa H. Hediger *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 93-100 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14D

The Advanced Computed Tomography Inspection System (ACTIS) was developed by NASA Marshall to support solid propulsion test programs. ACTIS represents a significant advance in state-of-the-art inspection systems. Its flexibility and superior technical performance have made ACTIS very popular, both within and outside the aerospace community. Through technology utilization efforts, ACTIS has been applied to inspection problems in commercial aerospace, lumber, automotive, and nuclear waste disposal industries. ACTIS has been used to inspect items of historical interest. ACTIS has consistently produced valuable results, providing information which was unattainable through conventional inspection methods. Although many successes have already been shown, the full potential of ACTIS has not yet been realized. It is currently being applied in the commercial aerospace industry by Boeing. Smaller systems, based on ACTIS technology, are becoming increasingly available. This technology has much to offer the small business and industry, especially in identifying design and process problems early in the product development cycle to prevent defects. Several options are available to businesses interested in this technology. Author

N92-22687*# Information Research Lab., Inc., Dartmouth, MA.
HIGH RESOLUTION ULTRASONIC SPECTROSCOPY SYSTEM FOR NONDESTRUCTIVE EVALUATION **c38**
C. H. Chen *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 101-104 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14D

With increased demand for high resolution ultrasonic evaluation, computer based systems or work stations become essential. The ultrasonic spectroscopy method of nondestructive evaluation (NDE) was used to develop a high resolution ultrasonic inspection system supported by modern signal processing, pattern recognition, and neural network technologies. The basic system which was completed consists of a 386/20 MHz PC (IBM AT compatible), a pulser/receiver, a digital oscilloscope with serial and parallel communications to the computer, an immersion tank with motor control of X-Y axis movement, and the supporting software package, IUNDE, for interactive ultrasonic evaluation. Although the hardware components are commercially available, the software development is entirely original. By integrating signal processing, pattern recognition, maximum entropy spectral analysis, and artificial neural network functions into the system, many NDE tasks can be performed. The high resolution graphics capability provides visualization of complex NDE problems. The phase 3 efforts involve intensive marketing of the software package and collaborative work with industrial sectors. Author

N92-22688*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FORCE LIMITED VIBRATION TESTING **c39**
Terry D. Scharton *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 105-115 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20K

A new method of conducting lab vibration tests of spacecraft equipment was developed to more closely simulate the vibration environment experienced when the spacecraft is launched on a rocket. The improved tests are tailored to identify equipment design and workmanship problems without inducing artificial failures that would not have occurred at launch. These new, less destructive types of vibration tests are essential to JPL's protoflight test approach in which lab testing is conducted using the flight equipment, often one of a kind, to save time and money. In conventional vibration tests, only the input vibratory motion is specified; the feedback, or reaction force, between the test item and the vibration machine is ignored. Most test failures occur when the test item goes into resonance, and the reaction force becomes very large. It has long been recognized that the large reaction force is a test artifact which does not occur with the lightweight, flexible mounting structures characteristic of spacecraft and space vehicles. In new vibration tests, both the motion and the force provided to the test item by the vibration machine are controlled, so that the vibration ride experienced by the test item is as in flight. Author

N92-22689*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF A ROTARY JOINT FLUID COUPLING FOR SPACE STATION FREEDOM **c37**
John A. Costulis *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 119-128 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

The design and development is described of a rotary joint fluid coupling for Space Station Freedom. The function of this fluid coupling is to transfer a heat rejection fluid between stationary and rotating interfaces with the Space Station thermal bus system. The design of this coupling incorporates a modular type design to allow maximum flexibility, two types of seals (mechanical face seals and shaft lip seals) for redundancy, materials with excellent ammonia compatibility, and coatings that enhance seal wear resistance and increased protection against corrosion. This design was thoroughly tested and met all design requirements. Potential applications of this hardware include uses in gun turrets, coal slurries, farming equipment, and any other applications that require the low leakage transfer of fluids between stationary and rotating interfaces. Author

N92-22690*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPLINE-LOCKING SCREW FASTENING STRATEGY (SLSFS) **c37**
John M. Vranish *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 129-135 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

A fastener was developed by NASA Goddard for efficiently performing assembly, maintenance, and equipment replacement functions in space using either robotic or astronaut means. This fastener, the 'Spline Locking Screw' (SLS) would also have significant commercial value in advanced manufacturing. Commercial (or DoD) products could be manufactured in such a way that their prime subassemblies would be assembled using SLS fasteners. This would permit machines and robots to disconnect and replace these modules/parts with ease, greatly reducing life cycle costs of the products and greatly enhancing the quality, timeliness, and consistency of repairs, upgrades, and remanufacturing. The operation of the basic SLS fastener is detailed, including hardware and test results. Its extension into a comprehensive fastening strategy for NASA use in space is also outlined. Following this, the discussion turns toward potential commercial and government applications and the potential market significance of same. Author

N92-22691*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
QUICK APPLICATION/RELEASE NUT WITH ENGAGEMENT INDICATOR (COMMERCIAL APPLICATION OF AN INNOVATIVE NUT DESIGN) **c37**
Jay M. Wright *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 136-139 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

This is an assembly which permits a fastener to be inserted or removed from either side with an indicator of fastener engagement. The nut has a plurality of segments, preferably at least three segments, which are internally threaded, spring loaded apart by an internal spring, and has detents on opposite sides which force the nut segments into operative engagement with a threaded member when pushed in and release the segments for quick insertion or removal of the fastener when moved out. When the nut is installed, end pressure on the detents presses the nut segments into operative engagement with a threaded member where continued rotation locks the structure together with the detents depressed to indicate positive locking engagement of the nut. On removal, counterclockwise rotation relieves the endwise pressure on the detents, permitting internal springs to force the detents outward, allowing the nut segments to move outward and separate to permit quick removal of the fastener. Author

N92-22692*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INFLATABLE TRAVERSING PROBE SEAL **c37**
Paul A. Trimarchi *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 140-145 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13K

An inflatable seal acts as a pressure-tight zipper to provide traversing capability for instrumentation rakes and probes. A specially designed probe segment with a teardrop cross-section

in the vicinity of the inflatable seal minimizes leakage at the interface. The probe is able to travel through a lengthwise slot in a pressure vessel or wind tunnel section, while still maintaining pressure integrity. The design uses two commercially available inflatable seals, opposing each other, to cover the probe slot in a wind tunnel wall. Proof-of-concept tests were conducted at vessel pressures up to 30 psig, with seals inflated to 50 psig, showing no measurable leakage along the seal's length or around the probe teardrop cross-section. This seal concept can replace the existing technology of sliding face plate/O-ring systems in applications where lengthwise space is limited. Author

N92-22693*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
CLIPS: AN EXPERT SYSTEM BUILDING TOOL c61
Gary Riley *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 149-158 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

The C Language Integrated Production System (CLIPS) is an expert system building tool, which provides a complete environment for the development and delivery of rule and/or object based expert systems. CLIPS was specifically designed to provide a low cost option for developing and deploying expert system applications across a wide range of hardware platforms. The commercial potential of CLIPS is vast. Currently, CLIPS is being used by over 3,300 individuals throughout the public and private sector. Because the CLIPS source code is readily available, numerous groups have used CLIPS as a basis for their own expert system tools. To date, three commercially available tools have been derived from CLIPS. In general, the development of CLIPS has helped to improve the ability to deliver expert system technology throughout the public and private sectors for a wide range of applications and diverse computing environments. Author

N92-22694*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FUZZY LOGIC APPLICATIONS TO EXPERT SYSTEMS AND CONTROL c63
Robert N. Lea and Yashvant Jani (Togai InfraLogic, Inc., Houston, TX.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 159-168 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

A considerable amount of work on the development of fuzzy logic algorithms and application to space related control problems has been done at the Johnson Space Center (JSC) over the past few years. Particularly, guidance control systems for space vehicles during proximity operations, learning systems utilizing neural networks, control of data processing during rendezvous navigation, collision avoidance algorithms, camera tracking controllers, and tether controllers have been developed utilizing fuzzy logic technology. Several other areas in which fuzzy sets and related concepts are being considered at JSC are diagnostic systems, control of robot arms, pattern recognition, and image processing. It has become evident, based on the commercial applications of fuzzy technology in Japan and China during the last few years, that this technology should be exploited by the government as well as private industry for energy savings. Author

N92-22695*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
NEURAL NETWORK TECHNOLOGIES c63
James A. Villarreal *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 169-173 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

A whole new arena of computer technologies is now beginning to form. Still in its infancy, neural network technology is a biologically inspired methodology which draws on nature's own cognitive processes. The Software Technology Branch has provided a software tool, Neural Execution and Training System (NETS), to industry, government, and academia to facilitate and expedite the use of this technology. NETS is written in the C programming language and can be executed on a variety of machines. Once a network has been debugged, NETS can produce a C source code which implements the network. This code can then be incorporated into other software systems. Described here are various software projects currently under development with NETS and the anticipated future enhancements to NETS and the technology. Author

N92-22696*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FROM BIOLOGICAL NEURAL NETWORKS TO THINKING MACHINES: TRANSITIONING BIOLOGICAL ORGANIZATIONAL PRINCIPLES TO COMPUTER TECHNOLOGY c63
Muriel D. Ross *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 174-180 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

The three-dimensional organization of the vestibular macula is under study by computer assisted reconstruction and simulation methods as a model for more complex neural systems. One goal of this research is to transition knowledge of biological neural network architecture and functioning to computer technology, to contribute to the development of thinking computers. Maculas are organized as weighted neural networks for parallel distributed processing of information. The network is characterized by non-linearity of its terminal/receptive fields. Wiring appears to develop through constrained randomness. A further property is the presence of two main circuits, highly channeled and distributed modifying, that are connected through feedforward-feedback collaterals and biasing subcircuit. Computer simulations demonstrate that differences in geometry of the feedback (afferent) collaterals affects the timing and the magnitude of voltage changes delivered to the spike initiation zone. Feedforward (efferent) collaterals act as voltage followers and likely inhibit neurons of the distributed modifying circuit. These results illustrate the importance of feedforward-feedback loops, of timing, and of inhibition in refining neural network output. They also suggest that it is the distributed modifying network that is most involved in adaptation, memory, and learning. Tests of macular adaptation, through hyper- and microgravitational studies, support this hypothesis since synapses in the distributed modifying circuit, but not the channeled circuit, are altered. Transitioning knowledge of biological systems to computer technology, however, remains problematical. Author

N92-22697*# Naval Research Lab., Washington, DC.
THE MICROASSAY ON A CARD: A RUGGED, PORTABLE IMMUNOASSAY c25
David Kidwell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 183-190 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

The Microassay on a Card (MAC) is a portable, hand-held, non-instrumental immunoassay that can test for the presence of a wide variety of substances in the environment. The MAC is a simple device to use. A drop of test solution is placed on one side of the card and within five minutes a color is developed on the other side in proportion to the amount of substance in the test solution, with sensitivity approaching 10 ng/ml. The MAC is self-contained and self-timed; no reagents or timing is necessary. The MAC may be configured with multiple wells to provide simultaneous testing for multiple species. As envisioned, the MAC will be employed first as an on-site screen for drugs of abuse in urine or saliva. If the MAC can be used as a screen of saliva for drugs of abuse, it could be applied to driving while intoxicated, use of drugs on the job, or testing of the identity of seized materials.

With appropriate modifications, the MAC also could be used to test for environmental toxins or pollutants. Author

N92-22698*# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
DETECTION OF SMALL MOLECULES WITH A FLOW IMMUNOSENSOR **c25**
Anne W. Kusterbeck and Frances S. Ligler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 191-196 Sponsored in part by FAA and United States Customs Service (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

We describe the development of an easy-to-use sensor with widespread applications for detecting small molecules. The flow immunosensor can analyze discrete samples in under one minute or continuously monitor a flowing stream for the presence of specific analytes. This detection system is extremely specific, and achieves a level of sensitivity which meets or exceeds the detection limits reported for rival assays. Because the system is also compact, transportable, and automated, it has the potential to impact diverse areas. For example, the flow immunosensor has successfully detected drugs of abuse and explosives, and may well address many of the needs of the environmental community with respect to continuous monitoring for pollutants. Efforts are underway to engineer a portable device in the field. Author

N92-22699*# Agricultural Research Service, Ames, IA. National Soil Tilth Lab.
NUCLEIC ACID PROBES IN DIAGNOSTIC MEDICINE **c52**
Phillip A. OBerry *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 197-201 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06B

The need for improved diagnostic procedures is outlined and variations in probe technology are briefly reviewed. A discussion of the application of probe technology to the diagnosis of disease in animals and humans is presented. A comparison of probe versus nonprobe diagnostics and isotopic versus nonisotopic probes is made and the current state of sequence amplification is described. The current market status of nucleic acid probes is reviewed with respect to their diagnostic application in human and veterinary medicine. Representative product examples are described and information on probes being developed that offer promise as future products is discussed. Author

N92-22700*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THE ROTATING SPECTROMETER: BIOTECHNOLOGY FOR CELL SEPARATIONS **c51**
David A. Noever *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 202-211 Previously announced as N91-15673 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06C

An instrument for biochemical studies, called the rotating spectrometer, separates previously inseparable cell cultures. The rotating spectrometer is intended for use in pharmacological studies which require fractional splitting of heterogeneous cell cultures based on cell morphology and swimming behavior. As a method to separate and concentrate cells in free solution, the rotating method requires active organism participation and can effectively split the large class of organisms known to form spontaneous patterns. Examples include the biochemical star, an organism called Tetrahymena pyriformis. Following focusing in a rotating frame, the separation is accomplished using different radial dependencies of concentrated algal and protozoan species. The focusing itself appears as concentric rings and arises from the coupling between swimming direction and Coriolis forces. A dense cut is taken at varying radii, and extraction is replenished at an inlet. Unlike standard separation and concentrating techniques such as filtration or centrifugation, the instrument is able to separate motile from immotile fractions. For a single pass, typical split efficiencies can reach 200 to 300 percent compared to the inlet concentration. Author

N92-22701*# Brookhaven National Lab., Upton, NY. Physics Dept.
A METHOD OF PRODUCING HIGH QUALITY OXIDE AND RELATED FILMS ON SURFACES **c27**
Mark W. Ruckman, Myron Strongin, and Yongli Gao (Rochester Univ., NY.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 215-224 Previously announced as N92-18740 Sponsored in part by Alfred P. Sloan Foundation (For primary document see N92-22676 13-99)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC/MF A22 CSCL 11C

Aluminum oxide or aluminum nitride films were deposited on molecular beam epitaxy (MBE) grown GaAS(100) using a novel cryogenic-based reactive thin film deposition technique. The process involves the condensation of molecular oxygen, ammonia, or other gases normally used for reactive thin film deposition on the substrate before the metal is deposited. The metal vapor is deposited into this layer and reacts with the molecular solid to form the desired compound or a precursor that can be thermally decomposed to generate the desired compound. The films produced by this method are free of impurities, and the low temperatures can be used to control the film and interfacial structure. The process can be easily integrated with existing MBE systems. Ongoing research using the same apparatus suggests that photon or electron irradiation could be used to promote the reactions needed to produce the intended material. Author

N92-22702*# Naval Research Lab., Washington, DC. Electronics Science and Technology Div.
ADVANCED SILICON ON INSULATOR TECHNOLOGY **c27**
D. Godbey, H. Hughes, and F. Kub *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 225-231 Sponsored in part by DNA Prepared in cooperation with ARACOR, Sunnyvale, CA (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11C

Undoped, thin-layer silicon-on-insulator was fabricated using wafer bonding and selective etching techniques employing a molecular beam epitaxy (MBE) grown Si0.7Ge0.3 layer as an etch stop. Defect free, undoped 200-350 nm silicon layers over silicon dioxide are routinely fabricated using this procedure. A new selective silicon-germanium etch was developed that significantly improves the ease of fabrication of the bond and etch back silicon insulator (BESOI) material. Author

N92-22703*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PERFORMANCE OF A HIGH T (SUB c) SUPERCONDUCTING ULTRA-LOW LOSS MICROWAVE STRIPLINE FILTER **c33**
J. J. Bautista, G. Ortiz, C. Zahopoulos, S. Sridhar, and M. Lanagan (Argonne National Lab., IL.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 232-238 Previously announced as N91-32255 and A91-27959 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09C

Discussed here is the successful fabrication of a five-pole interdigital stripline filter made of the 93 K superconductor (Y1Ba2Cu3O sub y) coated on a silver substrate, with center frequency of 8.5 GHz and an extremely high rejection ratio of 80 dB. The lowest injection loss measured was 0.1 dB at 12 K, with a return loss of better than 16 dB, representing a significant improvement over a similar copper filter, and is comparable to low critical temperature filters. The insertion loss appears to be limited by extrinsic factors, such as tuning mismatch and joint losses, and not by superconducting material losses. Author

N92-22704*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Center for Space Microelectronics Technology.
AN ADJUSTABLE RF TUNING ELEMENT FOR MICROWAVE, MILLIMETER WAVE, AND SUBMILLIMETER WAVE INTEGRATED CIRCUITS **c33**
Victor M. Lubecke, William R. McGrath, and David B. Rutledge (California Inst. of Tech., Pasadena.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 239-245 Sponsored in part by Strategic Defense Initiative Organization (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09C

Planar RF circuits are used in a wide range of applications from 1 GHz to 300 GHz, including radar, communications, commercial RF test instruments, and remote sensing radiometers. These circuits, however, provide only fixed tuning elements. This lack of adjustability puts severe demands on circuit design procedures and materials parameters. We have developed a novel tuning element which can be incorporated into the design of a planar circuit in order to allow active, post-fabrication tuning by varying the electrical length of a coplanar strip transmission line. It consists of a series of thin plates which can slide in unison along the transmission line, and the size and spacing of the plates are designed to provide a large reflection of RF power over a useful frequency bandwidth. Tests of this structure at 1 GHz to 3 Ghz showed that it produced a reflection coefficient greater than 0.90 over a 20 percent bandwidth. A 2 GHz circuit incorporating this tuning element was also tested to demonstrate practical tuning ranges. This structure can be fabricated for frequencies as high as 1000 GHz using existing micromachining techniques. Many commercial applications can benefit from this micromechanical RF tuning element, as it will aid in extending microwave integrated circuit technology into the high millimeter wave and submillimeter wave bands by easing constraints on circuit technology. Author

N92-22705*# Martin Marietta Corp., New Orleans, LA.
COMMERCIAL APPLICATION OF THERMAL PROTECTION SYSTEM TECHNOLOGY **c85**
Gordon L. Dyer *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 250-257 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 05A

The thermal protection system process technology is examined which is used in the manufacture of the External Tank for the Space Shuttle system and how that technology is applied by private business to create new products, new markets, and new American jobs. The term 'technology transfer' means different things to different people and has become one of the buzz words of the 1980s and 1990s. Herein, technology transfer is defined as a means of transferring technology developed by NASA's prime contractors to public and private sector industries. Author

N92-22706*# Army Lab. Command, Watertown, MA.
OXYNITRIDE GLASS FIBERS **c27**
Parimal J. Patel, Donald R. Messier, and R. E. Rich *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 258-264 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11C

Research at the Army Materials Technology Laboratory (AMTL) and elsewhere has shown that many glass properties including elastic modulus, hardness, and corrosion resistance are improved markedly by the substitution of nitrogen for oxygen in the glass structure. Oxynitride glasses, therefore, offer exciting opportunities for making high modulus, high strength fibers. Processes for making oxynitride glasses and fibers of glass compositions similar to commercial oxide glasses, but with considerable enhanced properties, are discussed. We have made glasses with elastic moduli as high as 140 GPa and fibers with moduli of 120 GPa and tensile strengths up to 2900 MPa. AMTL holds a U.S. patent on oxynitride glass fibers, and this presentation discusses a unique process for drawing small diameter oxynitride glass fibers at high drawing rates. Fibers are drawn through a nozzle from molten glass in a molybdenum crucible at 1550 C. The crucible is situated in a furnace chamber in flowing nitrogen, and the fiber is wound in air outside of the chamber, making the process straightforward and commercially feasible. Strengths were considerably improved by improving glass quality to minimize internal defects. Though the fiber strengths were comparable with oxide fibers, work is currently in progress to further improve the elastic modulus and strength of fibers. The high elastic modulus of oxynitride glasses indicate their potential for making fibers with tensile strengths surpassing any oxide glass fibers, and we hope to realize that potential in the near future. Author

N92-22707*# Midwest Research Inst., Golden, CO.
COMMERCIAL APPLICATIONS OF NEW PHOTOVOLTAIC TECHNOLOGIES **c44**
R. McConnell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 265-273 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 10A

The National Renewable Energy Laboratory (NREL) has directed and managed photovoltaic (PV) research and development (R&D) activities for the Department of Energy for more than 13 years. The NREL budget for these activities is almost $33 million for FY 1991. With the world's increasing concern for the environment and the United States' renewed apprehension over secure and adequate energy supplies, the use of semiconducting materials for the direct conversion of sunlight to electricity - photovoltaics - is an excellent example of government-supported high technology ready for further development by U.S. companies. Some new PV technologies and their research progress, some commercial applications of PV, and NREL's technology transfer activities for helping U.S. industry in its efforts to bring new products or services to the marketplace are described. Author

N92-22708*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SOFTWARE REENGINEERING **c61**
Ernest M. Fridge, III *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 277-286 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

Today's software systems generally use obsolete technology, are not integrated properly with other software systems, and are difficult and costly to maintain. The discipline of reverse engineering is becoming prominent as organizations try to move their systems up to more modern and maintainable technology in a cost effective manner. JSC created a significant set of tools to develop and maintain FORTRAN and C code during development of the Space Shuttle. This tool set forms the basis for an integrated environment to re-engineer existing code into modern software engineering structures which are then easier and less costly to maintain and which allow a fairly straightforward translation into other target languages. The environment will support these structures and practices even in areas where the language definition and compilers do not enforce good software engineering. The knowledge and data captured using the reverse engineering tools is passed to standard forward engineering tools to redesign or perform major upgrades to software systems in a much more cost effective manner than using older technologies. A beta vision of the environment was released in Mar. 1991. The commercial potential for such re-engineering tools is very great. CASE TRENDS magazine reported it to be the primary concern of over four hundred of the top MIS executives. Author

N92-22709*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COSTMODL: AN AUTOMATED SOFTWARE DEVELOPMENT COST ESTIMATION TOOL **c61**
George B. Roush *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition,

Volume 2 Dec. 1991 p 287-293 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

The cost of developing computer software continues to consume an increasing portion of many organizations' total budgets, both in the public and private sector. As this trend develops, the capability to produce reliable estimates of the effort and schedule required to develop a candidate software product takes on increasing importance. The COSTMODL program was developed to provide an in-house capability to perform development cost estimates for NASA software projects. COSTMODL is an automated software development cost estimation tool which incorporates five cost estimation algorithms including the latest models for the Ada language and incrementally developed products. The principal characteristic which sets COSTMODL apart from other software cost estimation programs is its capacity to be completely customized to a particular environment. The estimation equations can be recalibrated to reflect the programmer productivity characteristics demonstrated by the user's organization, and the set of significant factors which effect software development costs can be customized to reflect any unique properties of the user's development environment. Careful use of a capability such as COSTMODL can significantly reduce the risk of cost overruns and failed projects. Author

N92-22710*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INCREASING PRODUCTIVITY THROUGH TOTAL REUSE MANAGEMENT (TRM) c81
M. P. Schuler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 294-300 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 05A

Total Reuse Management (TRM) is a new concept currently being promoted by the NASA Langley Software Engineering and Ada Lab (SEAL). It uses concepts similar to those promoted in Total Quality Management (TQM). Both technical and management personnel are continually encouraged to think in terms of reuse. Reuse is not something that is aimed for after a product is completed, but rather it is built into the product from inception through development. Lowering software development costs, reducing risk, and increasing code reliability are the more prominent goals of TRM. Procedures and methods used to adopt and apply TRM are described. Reuse is frequently thought of as only being applicable to code. However, reuse can apply to all products and all phases of the software life cycle. These products include management and quality assurance plans, designs, and testing procedures. Specific examples of successfully reused products are given and future goals are discussed. Author

N92-22711*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE USE OF HYPERMEDIA TO INCREASE THE PRODUCTIVITY OF SOFTWARE DEVELOPMENT TEAMS c62
L. Stephen Coles *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 301-307 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

Rapid progress in low-cost commercial PC-class multimedia workstation technology will potentially have a dramatic impact on the productivity of distributed work groups of 50-100 software developers. Hypermedia/multimedia involves the seamless integration in a graphical user interface (GUI) of a wide variety of data structures, including high-resolution graphics, maps, images, voice, and full-motion video. Hypermedia will normally require the manipulation of large dynamic files for which relational data base technology and SQL servers are essential. Basic machine architecture, special-purpose video boards, video equipment, optical memory, software needed for animation, network technology, and the anticipated increase in productivity that will result for the introduction of hypermedia technology are covered. It is suggested that the cost of the hardware and software to support an individual multimedia workstation will be on the order of $10,000. Author

N92-22712*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A COST-EFFECTIVE INTELLIGENT ROBOTIC SYSTEM WITH DUAL-ARM DEXTEROUS COORDINATION AND REAL-TIME VISION c37
Neville I. Marzwell and Alexander Y. K. Chen (Scientific Research Associates, Inc., Glastonbury, CT.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 311-324 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13I

Dexterous coordination of manipulators based on the use of redundant degrees of freedom, multiple sensors, and built-in robot intelligence represents a critical breakthrough in development of advanced manufacturing technology. A cost-effective approach for achieving this new generation of robotics has been made possible by the unprecedented growth of the latest microcomputer and network systems. The resulting flexible automation offers the opportunity to improve the product quality, increase the reliability of the manufacturing process, and augment the production procedures for optimizing the utilization of the robotic system. Moreover, the Advanced Robotic System (ARS) is modular in design and can be upgraded by closely following technological advancements as they occur in various fields. This approach to manufacturing automation enhances the financial justification and ensures the long-term profitability and most efficient implementation of robotic technology. The new system also addresses a broad spectrum of manufacturing demand and has the potential to address both complex jobs as well as highly labor-intensive tasks. The ARS prototype employs the decomposed optimization technique in spatial planning. This technique is implemented to the framework of the sensor-actuator network to establish the general-purpose geometric reasoning system. The development computer system is a multiple microcomputer network system, which provides the architecture for executing the modular network computing algorithms. The knowledge-based approach used in both the robot vision subsystem and the manipulation control subsystems results in the real-time image processing vision-based capability. The vision-based task environment analysis capability and the responsive motion capability are under the command of the local intelligence centers. An array of ultrasonic, proximity, and optoelectronic sensors is used for path planning. The ARS currently has 18 degrees of freedom made up by two articulated arms, one movable robot head, and two charged coupled device (CCD) cameras for producing the stereoscopic views, and articulated cylindrical-type lower body, and an optional mobile base. A functional prototype is demonstrated. Author

N92-22713*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
HIGHER-ORDER NEURAL NETWORK SOFTWARE FOR DISTORTION INVARIANT OBJECT RECOGNITION c62
Max B. Reid and Lilly Spirkovska *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 325-334 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 09B

The state-of-the-art in pattern recognition for such applications as automatic target recognition and industrial robotic vision relies on digital image processing. We present a higher-order neural network model and software which performs the complete feature extraction-pattern classification paradigm required for automatic pattern recognition. Using a third-order neural network, we demonstrate complete, 100 percent accurate invariance to distortions of scale, position, and in-plate rotation. In a higher-order neural network, feature extraction is built into the network, and does not have to be learned. Only the relatively simple classification step must be learned. This is key to achieving very rapid training. The training set is much smaller than with standard neural network

software because the higher-order network only has to be shown one view of each object to be learned, not every possible view. The software and graphical user interface run on any Sun workstation. Results of the use of the neural software in autonomous robotic vision systems are presented. Such a system could have extensive application in robotic manufacturing.

Author

N92-22714*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CONSTRAINT-BASED SCHEDULING **c63**

Monte Zweben *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 335-351 (For primary document see N92-22676 13-99)

Avail: NTIS HC/MF A22 CSCL 09B

Precalibration activities for the Deep Space Network are time- and work force-intensive. Significant gains in available and efficiency could be realized by intelligently incorporating automation techniques. An approach to automation is presented based on the use of Temporal Dependency Networks (TDN's). A TDN represents an activity by breaking it down into its component pieces and formalizing the precedence and other constraints associated with lower-level activities. The representations used to implement a TDN and the underlying system architecture needed to support its use are described. The commercial applications of this technique are numerous. It has potential for application in any system which requires real-time, system-level control, and accurate monitoring of health, status, and configuration in an asynchronous environment.

Author

N92-22715*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

COMPASS: A GENERAL PURPOSE COMPUTER AIDED SCHEDULING TOOL **c61**

Mary Beth McMahon, Barry Fox (McDonnell-Douglas Space Systems Co., Houston, TX.), and Chris Culbert *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 352-357 (For primary document see N92-22676 13-99)

(Contract NAS9-17885)

Avail: NTIS HC/MF A22 CSCL 09B

COMPASS is a generic scheduling system developed by McDonnell Douglas under the direction of the Software Technology Branch at JSC. COMPASS is intended to illustrate the latest advances in scheduling technology and provide a basis from which custom scheduling systems can be built. COMPASS was written in Ada to promote readability and to conform to potential NASA Space Station Freedom standards. COMPASS has some unique characteristics that distinguishes it from commercial products. These characteristics are discussed and used to illustrate some differences between scheduling tools.

Author

N92-22716*# National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.

ELAS: A POWERFUL, GENERAL PURPOSE IMAGE PROCESSING PACKAGE **c61**

David Walters and Douglas Rickman *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 361-365 (For primary document see N92-22676 13-99)

Avail: NTIS HC/MF A22 CSCL 09B

ELAS is a software package which has been utilized as an image processing tool for more than a decade. It has been the source of several commercial packages. Now available on UNIX workstations it is a very powerful, flexible set of software. Applications at Stennis Space Center have included a very wide range of areas including medicine, forestry, geology, ecological modeling, and sonar imagery. It remains one of the most powerful image processing packages available, either commercially or in the public domain.

Author

N92-22717*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

TRANSPORTABLE APPLICATIONS ENVIRONMENT (TAE) PLUS: A NASA TOOL FOR BUILDING AND MANAGING GRAPHICAL USER INTERFACES **c61**

Martha R. Szczur *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 366-376 Previously announced as N91-24048 and A92-17607 (For primary document see N92-22676 13-99)

Avail: NTIS HC/MF A22 CSCL 09B

The Transportable Applications Environment (TAE) Plus, developed at GSFC, is an advanced portable user interface development environment which simplifies the process of creating and managing complex application graphical user interfaces (GUI's), supports prototyping, allows applications to be ported easily between different platforms and encourages appropriate levels of user interface consistency between applications. The following topics are discussed: the capabilities of the TAE Plus tool; how the implementation has utilized state-of-the-art technologies within graphic workstations; and how it has been used both within and outside of NASA.

Author

N92-22718*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INSTRUMENTATION, PERFORMANCE VISUALIZATION, AND DEBUGGING TOOLS FOR MULTIPROCESSORS **c61**

Jerry C. Yan, Charles E. Fineman (Sterling Federal Systems, Inc., Moffett Field, CA.), and Philip J. Hontalas *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 377-385 (For primary document see N92-22676 13-99)

Avail: NTIS HC/MF A22 CSCL 09B

The need for computing power has forced a migration from serial computation on a single processor to parallel processing on multiprocessor architectures. However, without effective means to monitor (and visualize) program execution, debugging, and tuning parallel programs becomes intractably difficult as program complexity increases with the number of processors. Research on performance evaluation tools for multiprocessors is being carried out at ARC. Besides investigating new techniques for instrumenting, monitoring, and presenting the state of parallel program execution in a coherent and user-friendly manner, prototypes of software tools are being incorporated into the run-time environments of various hardware testbeds to evaluate their impact on user productivity. Our current tool set, the Ames Instrumentation Systems (AIMS), incorporates features from various software systems developed in academia and industry. The execution of FORTRAN programs on the Intel iPSC/860 can be automatically instrumented and monitored. Performance data collected in this manner can be displayed graphically on workstations supporting X-Windows. We have successfully compared various parallel algorithms for computational fluid dynamics (CFD) applications in collaboration with scientists from the Numerical Aerodynamic Simulation Systems Division. By performing these comparisons, we show that performance monitors and debuggers such as AIMS are practical and can illuminate the complex dynamics that occur within parallel programs.

Author

N92-22719*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

OPERATIONS AUTOMATION USING TEMPORAL DEPENDENCY NETWORKS **c32**

Lynne P. Cooper *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 386-393 (For primary document see N92-22676 13-99)

Avail: NTIS HC/MF A22 CSCL 17B

Precalibration activities for the Deep Space Network are time- and work force-intensive. Significant gains in availability and efficiency could be realized by intelligently incorporating automation techniques. An approach is presented to automation based on the use of Temporal Dependency Networks (TDNs). A TDN

represents an activity by breaking it down into its component pieces and formalizing the precedence and other constraints associated with lower level activities. The representations are described which are used to implement a TDN and the underlying system architecture needed to support its use. The commercial applications of this technique are numerous. It has potential for application in any system which requires real-time, system-level control, and accurate monitoring of health, status, and configuration in an asynchronous environment. Author

N92-22720*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
THERMOACOUSTIC REFRIGERATION c31
Steven L. Garrett and Thomas J. Hofler *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 397-406 Sponsored in part by ONR and Office of Naval Technology (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 13B

A new refrigerator which uses resonant high amplitude sound in inert gases to pump heat is described and demonstrated. The phasing of the thermoacoustic cycle is provided by thermal conduction. This 'natural' phasing allows the entire refrigerator to operate with only one moving part (the loudspeaker diaphragm). The thermoacoustic refrigerator has no sliding seals, requires no lubrication, uses only low-tolerance machine parts, and contains no expensive components. Because the compressor moving mass is typically small and the oscillation frequency is high, the small amount of vibration is very easily isolated. This low vibration and lack of sliding seals makes thermoacoustic refrigeration an excellent candidate for food refrigeration and commercial/residential air conditioning applications. The design, fabrication, and performance of the first practical, autonomous thermoacoustic refrigerator, which will be flown on the Space Shuttle (STS-42), are described, and designs for terrestrial applications are presented. Author

N92-22721*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
AMBIENT TEMPERATURE RECORDER c35
Larry D. Russell *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 407-414 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14B

A temperature data recorder, designated the Ambient Temperature Recorder (ATR-4), was developed at NASA Ames Research Center to meet particular requirements for space life sciences experiments. The small, self-contained, four-channel, battery-powered device records 32 kilobytes of temperature data over a range of -40 to +60 C at four sampling intervals ranging from 1.875 to 15 minutes. Data is stored in its internal electronic memory for later readout by a personal computer. Author

N92-22722*# Naval Postgraduate School, Monterey, CA. Dept. of Physics.
FIBER-OPTIC PUSH-PULL SENSOR SYSTEMS c74
David L. Gardner, David A. Brown, and Steven L. Garrett *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 415-422 Sponsored in part by NOAA and Naval Sea Systems Command (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20F

Fiber-optic push-pull sensors are those which exploit the intrinsically differential nature of an interferometer with concommitant benefits in common-mode rejection of undesired effects. Several fiber-optic accelerometer and hydrophone designs are described. Additionally, the recent development at the Naval Postgraduate School of a passive low-cost interferometric signal demodulator permits the development of economical fiber-optic sensor systems. Author

N92-22723*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COMMERCIAL CAPACIFLECTOR c35
John M. Vranish *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 423-434 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14B

A capacitive proximity/tactile sensor with unique performance capabilities ('capaciflector' or capacitive reflector) is being developed by NASA/Goddard Space Flight Center (GSFC) for use on robots and payloads in space in the interests of safety, efficiency, and ease of operation. Specifically, this sensor will permit robots and their attached payloads to avoid collisions in space with humans and other objects and to dock these payloads in a cluttered environment. The sensor is simple, robust, and inexpensive to manufacture with obvious and recognized commercial possibilities. Accordingly, NASA/GSFC, in conjunction with industry, is embarking on an effort to 'spin' this technology off into the private sector. This effort includes prototypes aimed at commercial applications. The principles of operation of these prototypes are described along with hardware, software, modelling, and test results. The hardware description includes both the physical sensor in terms of a flexible printed circuit board and the electronic circuitry. The software description will include filtering and detection techniques. The modelling will involve finite element electric field analysis and will underline techniques used for design optimization. Author

N92-22724*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
WATER QUALITY MONITOR (EMPAX INSTRUMENT) c25
Warren C. Kelliher, Ben Clark, and Mike Thornton (Martin Marietta Corp., Denver, CO.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 437-444 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

The impetus of the Viking Mission to Mars led to the first miniaturization of a X-ray Fluorescence Spectrometer (XRFS). Two units were flown on the Viking Mission and successfully operated for two years analyzing the elemental composition of the Martian soil. Under a Bureau of Mines/NASA Technology Utilization project, this XRFS design was utilized to produce a battery powered, portable unit for elemental analysis of geological samples. This paper will detail design improvements and additional sampling capabilities that were incorporated into a second generation portable XRFS that was funded by the EPA/NASA Technology Utilization project. The unit, Environment Monitoring with Portable Analysis by X-ray (EMPAX), was developed specifically for quantitative determination of the need of EPA and and any industry affected by environmental concerns, the EMPAX fulfills a critical need to provide on-site, real-time analysis of toxic metal contamination. A patent was issued on EMPAX, but a commercial manufacturer is still being sought. Author

N92-22725*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
REMOTE SEMI-CONTINUOUS FLOW RATE LOGGING SEEPAGE METER c35
William G. Reay (Virginia Polytechnic Inst. and State Univ., Blacksburg.) and Harry G. Walthall *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 445-451 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 14B

The movement of groundwater and its associated solutes from upland regions was implicated in the degradation of receiving surface water bodies. Current efforts to directly measure this influx of water incorporate manually operated seepage meters which are hindered by severe limitations. A prototype seepage meter was developed by NASA Langley Research Center and Virginia Polytechnic Institute and State University that will allow for the

semi-continuous collection and data logging of seepage flux across the sediment water interface. The meter is designed to operate at depths to 40 meters, and alleviate or minimize all disadvantages associated with traditional methods while remaining cost effective. The unit was designed to operate independently for time periods on the order of weeks with adjustable sample sequences depending upon hydrologic conditions. When used in conjunction with commercially available pressure transducers, this seepage meter allows for correlations to be made between groundwater discharge and tidal/sea state conditions in coastal areas. Field data from the Chesapeake Bay and Florida Bay systems are presented.
Author

N92-22726*# Naval Weapons Center, China Lake, CA. Chemistry Div.
CALCIFICATION PREVENTION TABLETS c25
Geoffrey A. Lindsay, Michael A. Hasting, and Michael A. Gustavson (Naval Sea Systems Command, Bremerton, WA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 452-458 Sponsored in part by Commanders Naval Air Forces US Atlantic and Pacific Fleet (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

Citric acid tablets, which slowly release citric acid when flushed with water, are under development by the Navy for calcification prevention. The citric acid dissolves calcium carbonate deposits and chelates the calcium. For use in urinals, a dispenser is not required because the tablets are non-toxic and safe to handle. The tablets are placed in the bottom of the urinal, and are consumed in several hundred flushes (the release rate can be tailored by adjusting the formulation). All of the ingredients are environmentally biodegradable. Mass production of the tablets on commercial tableting machines was demonstrated. The tablets are inexpensive (about 75 cents apiece). Incidences of clogged pipes and urinals were greatly decreased in long term shipboard tests. The corrosion rate of sewage collection pipe (90/10 Cu/Ni) in citric acid solution in the laboratory is several mils per year at conditions typically found in traps under the urinals. The only shipboard corrosion seen to date is of the yellow brass urinal tail pieces. While this is acceptable, the search for a nontoxic corrosion inhibitor is underway. The shelf life of the tablets is at least one year if stored at 50 percent relative humidity, and longer if stored in sealed plastic buckets.
Author

N92-22727*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTOMATED CARBON DIOXIDE CLEANING SYSTEM c25
David T. Hoppe *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 459-465 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

Solidified CO2 pellets are an effective blast media for the cleaning of a variety of materials. CO2 is obtained from the waste gas streams generated from other manufacturing processes and therefore does not contribute to the greenhouse effect, depletion of the ozone layer, or the environmental burden of hazardous waste disposal. The system is capable of removing as much as 90 percent of the contamination from a surface in one pass or to a high cleanliness level after multiple passes. Although the system is packaged and designed for manual hand held cleaning processes, the nozzle can easily be attached to the end effector of a robot for automated cleaning of predefined and known geometries. Specific tailoring of cleaning parameters are required to optimize the process for each individual geometry. Using optimum cleaning parameters the CO2 systems were shown to be capable of cleaning to molecular levels below 0.7 mg/sq ft. The systems were effective for removing a variety of contaminants such as lubricating oils, cutting oils, grease, alcohol residue, biological films, and silicone. The system was effective on steel, aluminum, and carbon phenolic substrates.
Author

N92-22728*# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
ADVANCED COMPOSITE APPLICATIONS FOR SUB-MICRON BIOLOGICALLY DERIVED MICROSTRUCTURES c24
J. M. Schnur, R. R. Price, P. E. Schoen, Joseph Bonanventura, and Douglas Kirkpatrick (Science Applications International Corp., McLean, VA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 469-479 Sponsored in part by ONR; Office of Naval Technology; DARPA; and NSF (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 11D

A major thrust of advanced material development is in the area of self-assembled ultra-fine particulate based composites (micro-composites). The application of biologically derived, self-assembled microstructures to form advanced composite materials is discussed. Hollow 0.5 micron diameter cylindrical shaped microcylinders self-assemble from diacetylenic lipids. These microstructures have a multiplicity of potential applications in the material sciences. Exploratory development is proceeding in application areas such as controlled release for drug delivery, wound repair, and biofouling as well as composites for electronic and magnetic applications, and high power microwave cathodes.
Author

N92-22729*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
STRUCTURAL MODIFICATION OF POLYSACCHARIDES: A BIOCHEMICAL-GENETIC APPROACH c51
Roger G. Kern and Gene R. Petersen *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 480-485 Sponsored in part by Defense Advanced Research Projects Agency (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06C

Polysaccharides have a wide range of industrial and biomedical applications. An industry trend is underway towards the increased use of bacteria to produce polysaccharides. Long term goals of this work are the adaptation and enhancement of saccharide properties for electronic and optic applications. In this report we illustrate the application of enzyme-bearing bacteriophage on strains of the enteric bacterium Klebsiella pneumoniae, which produces a polysaccharide with the relatively rare rheological property of drag-reduction. This has resulted in the production of new polysaccharides with enhanced rheological properties. Our laboratory is developing techniques for processing and structurally modifying bacterial polysaccharides and oligosaccharides which comprise their basic polymeric repeat units. Our research has focused on bacteriophage which produce specific polysaccharide degrading enzymes. This has lead to the development of enzymes generated by bacteriophage as tools for polysaccharide modification and purification. These enzymes were used to efficiently convert the native material to uniform-sized high molecular weight polymers, or alternatively into high-purity oligosaccharides. Enzyme-bearing bacteriophage also serve as genetic selection tools for bacteria that produce new families of polysaccharides with modified structures.
Author

N92-22730*# Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
CRYOGENIC FOCUSSING, OHMICALLY HEATED ON-COLUMN TRAP c25
Stephen R. Springston *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 486-494 (For primary document see N92-22676 13-99)
(Contract DE-AC02-76CH-00016)
Avail: NTIS HC/MF A22 CSCL 07D

A procedure is described for depositing a conductive layer of gold on the exterior of a fused-silica capillary used in gas chromatography. By subjecting a section of the column near the inlet to a thermal cycle of cryogenic cooling and ohmic heating, volatile samples are concentrated and subsequently injected. The

performance of this trap as a chromatographic injector is demonstrated. Several additional applications are suggested and the unique properties of this device are discussed. Author

N92-22731*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
XPS STUDY OF THE EFFECT OF HYDROCARBON CONTAMINATION ON POLYTETRAFLUOROETHYLENE (TEFLON) EXPOSED TO ATOMIC OXYGEN c25
Morton A. Golub, Theodore Wydeven, and Robert D. Cormia (Surface Science Labs., Mountain View, CA.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 495-499 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 07D

The presence of hydrocarbon contamination on the surface of polytetrafluoroethylene (PTFE) markedly affects the oxygen uptake, and hence the wettability, of this polymer when exposed to an oxygen plasma. As revealed by X-ray photoelectron spectroscopy (XPS) analysis, the oxygen-to-carbon ratio (O/C) for such a polymer can increase sharply, and correspondingly the fluorine-to-carbon ratio (F/C) can decrease sharply, at very short exposure times; at longer times, however, such changes in the O/C and F/C ratios reverse direction, and these ratios then assume values similar to those of the unexposed PTFE. The greater the extent of hydrocarbon contamination in the PTFE, the larger are the amplitudes of the 'spikes' in the O/C- and F/C-exposure time plots. In contrast, a pristine PTFE experiences a very small, monotonic increase of surface oxidation or O/C ratio with time of exposure to oxygen atoms, while the F/C ratio is virtually unchanged from that of the unexposed polymer (2.0). Unless the presence of adventitious hydrocarbon is taken into account, anomalous surface properties relating to polymer adhesion may be improperly ascribed to PTFE exposed to an oxygen plasma. Author

N92-22732*# Strategic Defense Initiative Organization, Washington, DC. Office of Technology Applications.
APPLICATIONS OF THE STRATEGIC DEFENSE INITIATIVE'S COMPACT ACCELERATORS c72
Nick Montanarelli and Ted Lynch *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 503-511 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 20H

The Strategic Defense Initiative's (SDI) investment in particle accelerator technology for its directed energy weapons program has produced breakthroughs in the size and power of new accelerators. These accelerators, in turn, have produced spinoffs in several areas: the radio frequency quadrupole linear accelerator (RFQ linac) was recently incorporated into the design of a cancer therapy unit at the Loma Linda University Medical Center, an SDI-sponsored compact induction linear accelerator may replace Cobalt-60 radiation and hazardous ethylene-oxide as a method for sterilizing medical products, and other SDIO-funded accelerators may be used to produce the radioactive isotopes oxygen-15, nitrogen-13, carbon-11, and fluorine-18 for positron emission tomography (PET). Other applications of these accelerators include bomb detection, non-destructive inspection, decomposing toxic substances in contaminated ground water, and eliminating nuclear waste. Author

N92-22733*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACOUSTICALLY BASED FETAL HEART RATE MONITOR c52
Donald A. Baker (Baker Guardian Medical Labs., Spokane, WA.) and Allan J. Zuckerwar *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 512-517 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06B

The acoustically based fetal heart rate monitor permits an expectant mother to perform the fetal Non-Stress Test in her home. The potential market would include the one million U.S. pregnancies per year requiring this type of prenatal surveillance. The monitor uses polyvinylidene fluoride (PVF2) piezoelectric polymer film for the acoustic sensors, which are mounted in a seven-element array on a cummerbund. Evaluation of the sensor ouput signals utilizes a digital signal processor, which performs a linear prediction routine in real time. Clinical tests reveal that the acoustically based monitor provides Non-Stress Test records which are comparable to those obtained with a commercial ultrasonic transducer. Author

N92-22734*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SURGICAL FORCE DETECTION PROBE c52
Ping Tcheng, Paul Roberts, Charles Scott, and Richard Prass (Eastern Virginia Medical School,. Norfolk.) *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 518-532 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 06B

The development progress of a precision electro-mechanical instrument which allows the detection and documentation of the forces and moment applied to human tissue during surgery (under actual operation room conditions), is reported. The pen-shaped prototype probe which measures 1/2 inch in diameter and 7 inches in length was fabricated using an aerodynamic balance. The aerodynamic balance, a standard wind tunnel force and moment sensing transducer, measures the forces and the moments transmitted through the surgeon's hand to the human tissue during surgery. The prototype probe which was fabricated as a development tool was tested successfully. The final version of the surgical force detection probe will be designed based on additional laboratory tests in order to establish the full scale loads. It is expected that the final product will require a simplified aerodynamic balance with two or three force components and one moment component with lighter full scale loads. A signal conditioner was fabricated to process and display the outputs from the prototype probe. This unit will be interfaced with a PC-based data system to provide automatic data acquisition, data processing, and graphics display. The expected overall accuracy of the probe is better than one percent full scale. Author

N92-22735*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
DYNAMIC INTER-LIMB RESISTANCE EXERCISE DEVICE FOR LONG-DURATION SPACE FLIGHT c54
Douglas F. Schwandt, Donald E. Watenpaugh, Scott E. Parazynski, and Alan R. Hargens *In* NASA, Washington, Technology 2001: The Second National Technology Transfer Conference and Exposition, Volume 2 Dec. 1991 p 533-537 (For primary document see N92-22676 13-99)
Avail: NTIS HC/MF A22 CSCL 05H

Essential for fitness on Earth, resistive exercise is even more important for astronauts, who must maintain muscle and bone strength in the absence of gravity. To meet this need, designers and scientists at NASA Ames Research Center, Life Science Division, have worked to develop more effective exercise devices for long-duration exposure to microgravity. One of these concepts is the Inter-Limb Resistance Device which allows the subject to exercise one limb directly against another, strengthening muscle groups in the arms, legs, and back. It features a modular harness with an inelastic cable and instrumented pulley. Forces similar to other high resistance exercise equipment are generated. Sensors in the pulley measure force and velocity for performance feedback display and data acquisition. This free-floating apparatus avoids vibration of sensitive experiments on board spacecraft. Compact with low mass, this hardware is also well suited for a 'safe haven' from radiation on board Space Station Freedom, and may prove useful in confined environments on Earth, such as Antarctic stations, submarines, and other underwater habitats. Potential spin-offs of this technology include products for personal strengthening and cardiovascular conditioning, rehabilitation of hospital patients, fitness exercise for the disabled, and retraining after sports injuries. Author

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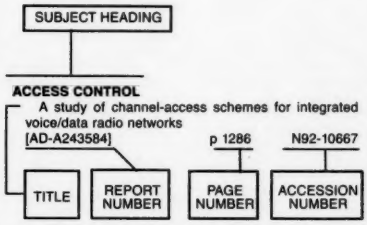

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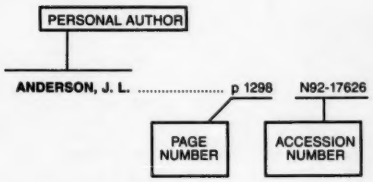

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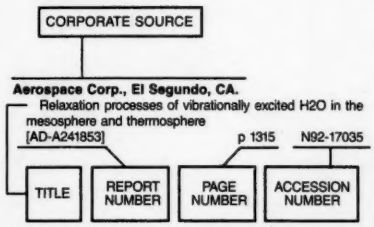

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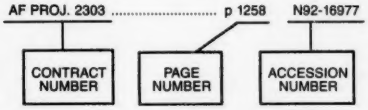

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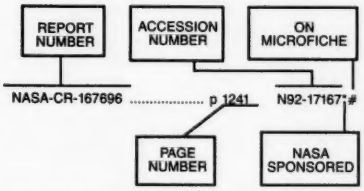

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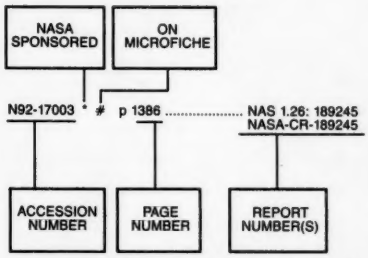

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Denver Federal Center, MS914
Denver, Colorado 80225

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(Effective October 1, 1991)

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